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REAUTHORIZATION OF THE NATIONAL SEA GRANT COLLEGE PROGRAM, 1983

HEARING

BEFORE THE

SUBCOMMITTEE ON
EDUCATION, ARTS AND HUMANITIES

OF THE

COMMITTEE ON
LABOR AND HUMAN RESOURCES
UNITED STATES SENATE

NINETY-EIGHTH CONGRESS

FIRST SESSION

ON

S. 655

TO AUTHORIZE APPROPRIATIONS TO CARRY OUT THE NATIONAL SEA GRANT PROGRAM FOR FISCAL YEARS 1984, 1985, AND 1986, AND FOR OTHER PURPOSES

APRIL 7, 1983

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REAUTHORIZATION OF THE NATIONAL SEA GRANT COLLEGE PROGRAM, 1983

THURSDAY, APRIL 7, 1983

U.S. SENATE,
SUBCOMMITTEE ON EDUCATION, ARTS AND HUMANITIES,
COMMITTEE ON LABOR AND HUMAN RESOURCES,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:02 a.m., in room SD-430, Dirksen Senate Office Building, Senator Claiborne Pell presiding pro tempore.

Present: Senator Pell.

OPENING STATEMENT OF SENATOR PELL

Senator PELL. The Subcommittee on Education, Arts, and Humanities will come to order, and I see so many old familiar friends and faces; I welcome you all here.

The hearing this morning will focus upon the sea grant college program and S. 655, the reauthorization legislation introduced on March 2. We have a number of very distinguished witnesses who will testify. They include individuals who have had direct experience with the educational component of the sea grant program and will thus be able to offer valuable insight and information on how that component functions.

In addition, we have a representative from the administration and we are all most interested in what he will have to say in light of the administration's proposal to terminate the sea grant college program.

In that regard, I must emphasize how disheartened I am that the administration has sought for the past 2 years to dismantle this very fine program. In fact, were it not for the strong support from both sides of the aisle in Congress, I fear this program would already have been ended.

This year, the administration not only wants to end the sea grant program, but also has added the National Advisory Committee on Oceans and Atmosphere [NACOA] to its hit list.

Further, in the international arena we have seen the United States under this administration withdraw from playing a significant role in forging an effective international agreement governing the use of the seas and seabeds; by this, naturally, I am referring to the law of the sea.

As the author of the original legislation that established the national sea grant program and as one who has witnessed many of its accomplishments and is very conscious of its cost-benefit record, I am deeply concerned with the actions and proposals of the administration. To my mind, they lay bare an administration that is bent on dismantling a comprehensive oceans policy, an action I believe would have harmful consequences at home and abroad.

I emphasize the point that while we are focusing on the sea grant college program today, we are conscious as we do so of all these other actions to extinguish or dismantle our activities in the oceans in other ways, whether it is through the extinguishing of NACOA or whether it is through the fact that we will not be signing the Law of the Sea treaty.

In any case, getting back to the focus of this hearing, the testimony concerning the sea grant college program, I look forward to hearing the witnesses.

The first witness we have is Mr. Winchester, representing the administration. I welcome you here, Mr. Winchester, and if you have a colleague with you, maybe you would give his name and introduce him to the subcommittee.

STATEMENT OF JAMES W. WINCHESTER, ASSOCIATE ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE, WASHINGTON, D.C., ACCOMPANIED BY ROBERT WILDMAN, DEPUTY DIRECTOR, SEA GRANT PROGRAM, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Mr. **Winchester**. Thank you, Mr. Chairman. My name is James W. Winchester. I am the Associate Administrator of the National Oceanic and Atmospheric Administration. I have with me here Mr. Robert Wildman, who is the Deputy Director of the sea grant program, and Mr. Wildman will be able to answer any specific questions that I might not have the answers to.

Senator **Pell**. I cannot quite hear. What is the function of your colleague, Mr. Wildman?

Mr. **Winchester**. He will sit here with me, with your permission, sir, and would answer some detailed questions that I might not have the answer to concerning this program.

Senator **Pell**. And your job, sir, is what again?

Mr. **Winchester**. I am the Associate Administrator of the National Oceanic and Atmospheric Administration.

Senator **Pell**. Right.

Mr. **Winchester**. And Mr. Wildman is the Deputy Director of the sea grant program in our Office of Oceanic and Atmospheric Research.

Senator **Pell**. And who is the Director of the program?

Mr. **Winchester**. Ned Ostenso.

Senator **Pell**. Ned Ostenso, my recollection is the Director.

Mr. **Winchester**. Right, and he is out of town at this time.

Senator **Pell**. I see, and you are here in lieu of Ned Ostenso.

Mr. **Winchester**. That is right.

Senator **Pell**. Right; thank you.

Mr. **Winchester**. And Bob is Ned's deputy.

Senator **Pell**. And would you speak up as you are? If people in the audience cannot hear, wave a hand and we will speak up.

Mr. WINCHESTER. All right. I will bring the mike up a little closer; maybe that will help.

Senator PELL. Thank you very much.

Mr. WINCHESTER. I am pleased to be here today to testify on behalf of the National Oceanic and Atmospheric Administration with regard to S. 655, authorizing appropriations for the national sea grant college program for fiscal years 1984, 1985, and 1986.

I have submitted for the record a prepared statement. With your permission, Mr. Chairman, I would like to summarize that statement at this time.

Senator PELL. Absolutely, and I look forward to hearing your summary. The statement will be inserted in the record in full as if read.

Mr. WINCHESTER. Thank you, Mr. Chairman.

The program was authorized in 1966 and made its first grant 15 years ago. The objective was to create a network of colleges and universities with rigorous programs in marine education and research. That objective has been realized because we now have 175 academic institutions participating in the program, 19 of which have been designated sea grant colleges by the Secretary of Commerce.

The program has consistently focused on solving regional marine resource problems and/or promoting opportunities for profitable utilization of regional marine resources.

When the program began, there was a great need for skilled manpower for marine resource development, and over the past 15 years sea grant funds have been invested in a variety of academic programs, including seminars and graduate training opportunities.

About 7,000 students have participated in the sea grant research or course work. Over the past 15 years, sea grant has helped a number of universities initiate or improve curricula in marine studies.

Successful sea grant-supported educational programs have been implemented at a number of universities, including the University of New Hampshire [MIT], the University of Delaware, the University of North Carolina, the University of Rhode Island, the University of Michigan, and several junior colleges throughout the United States.

Those activities are still useful, but they are essentially local or regional in importance, and some of these programs initiated with sea grant support now continue without Federal funds.

Furthermore, sea grant educational and training programs have now supplied about as much skilled manpower as the marine resource development industry can employ. In 1982, about one-third of the individuals that received sea grant support were faculty and professionals engaged in research, and we believe that the higher priority research programs will be continued by other sources if Federal sea grant funding is terminated.

Another prong of the sea grant program is the Marine Advisory Service. The Marine Advisory Service operates in 29 States and Puerto Rico. It disseminates research findings to industry, local, and State governments, and the general public.

The Marine Advisory Service conducts programs in fisheries, coastal management, marine education, aquaculture, recreation and tourism, seafood processing, pollution, transportation, and other marine-related miscellaneous activities.

However, those services, too, benefit primarily local and regional areas, and a continuation of such programs should primarily be the responsibility of local government and local private industry.

Now, the third prong of the sea grant program was to assist local governments and the marine industry in protecting and profitably developing regional marine resources. The Federal Government has certainly done its part in achieving that goal.

Fifteen years of carefully targeted efforts have paid off in programs of practical benefit to countless communities and local enterprises.

Now the time has come for us to back off and let State and local governments and the private sector take up the slack, and that, in fact, is exactly what is happening. Now, let me cite just four typical examples of matching funds provided by private industry.

One, a CBS radio station in Los Angeles now donates $100,000 worth of broadcast time per year for broadcast of marine weather information that is prepared by the University of Southern California sea grant program.

Two, genetic and diet studies of pen-cultured Coho salmon at the University of Washington are financed by Dom-Sea Farms, a commercial grower, to the extent of $90,000 per year.

Three, Grumman-Allied Industries gave equipment and services valued at $23,000 to help the University of Rhode Island study methods to extend the storage life of fresh fish.

Four, the technology transfer program of the Massachusetts Institute of Technology Marine Industry Advisory Service is subsidized by $86,900 in matching funds provided by 100 different companies.

The total of such private support to the sea grant program is $2,713,700. Now, the most salient point for us to consider today, as Secretary Baldrige said in recent testimony, is that sea grant is local or regional in nature and that it has attained its goals. It can boast of a number of successes.

But those aspects of the programs still deemed educationally or commercially worthwhile should be financed henceforth entirely by State or local governments or by private industry; 14 State legislatures already appropriate funds explicitly for this purpose. For example, in 1982, State and local governments and industry and university sources provided more than $22 million for various sea grant projects; 2.7 million of that was contributed by industry, and 19.2 million by State and local governments and by academic institutions.

Matching contributions to sea grant awarded this year are somewhat less than they were in 1982, but there have been some increases. For example, Mississippi, Alabama, Puerto Rico, Maryland, Maine, and New Hampshire have raised their commitments by a total of $357,000.

Throughout the history of the program, matching funds have invariably exceeded the required minimum. In fact, over 40 percent of the program is currently supported by matching funds. Clearly, no sea grant activity is inherently Federal in character. And none can make a rational claim upon the Federal budget in a time of severe fiscal constraints.

In general, the most productive and useful sea grant programs will be picked up and developed further by the private sector.

Mr. Chairman, this concludes the summary of my prepared statement. I would be happy to answer questions at this time.

[The prepared statement of Mr. Winchester follows:]

STATEMENT OF

JAMES W. WINCHESTER
ASSOCIATE ADMINISTRATOR

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

before the

SUBCOMMITTEE ON EDUCATION, ARTS AND HUMANITIES
of the
COMMITTEE ON LABOR AND HUMAN RESOURCES

UNITED STATES SENATE

April 7, 1983

Mr. Chairman, and Members of the Subcommittee:

I am pleased to be here today to testify on behalf of the National Oceanic and Atmospheric Administration with regard to S. 655, authorizing appropriations for the National Sea Grant College Program for fiscal years 1984, 1985, and 1986.

The Program was authorized in 1966 and made its first matching grants fifteen years ago. It was visualized as the moving force in the creation of a network of colleges and universities with rigorous programs in marine education and research. This objective has been realized. Today the program embraces some 175 academic institutions, nineteen of which have been designated Sea Grant Colleges by the Secretary of Commerce.

Programs are conceived and managed principally at the state or bi-state levels. Indeed, Sea Grant research has generally focused on solving regional marine resource problems or promoting opportunities for profitable resource utilization in a regional context.

To provide the skilled manpower for marine resource development, Sea Grant funds have been invested over the past decade and a half in a variety of new academic programs, seminars and graduate training opportunities in advanced research. Almost 7,000 students have participated in Sea Grant-sponsored research or course work. Last year, 490 projects engaged 985 university faculty members, 418 graduate students, 182 undergraduates, and 390 others (557 full-time equivalents).

Marine Advisory Services (MAS) operating in 29 states and Puerto Rico disseminate research findings to industry, local and state governments, and the general public. The MAS conduct programs in fisheries, coastal management, marine education, aquaculture, recreation/tourism, seafood processing, pollution, transportation/ports and other marine-related miscellaneous activities.

The most salient points for us to consider today, as Secretary Baldrige said in recent testimony, are that Sea Grant is local or regional in nature and that it has attained its goals. It can boast a number of successes. But those aspects of the program still deemed educationally or commercially worthwhile should be financed henceforth entirely by state or local governments or by private sources. Fourteen state legislatures already appropriate funds explicitly for for this purpose.

Indeed, in fiscal year 1982, state and local governments, industry and university sources provided more than $22 million for various Sea Grant projects. Of this amount, $2.7 million was contributed by private industry, and $19.2 million by state and local governments and by academic institutions. Grants awarded this fiscal year include matching contributions averaging somewhat less than in fiscal year 1982; some are up while others are down. Four participants -- Mississippi/Alabama, Puerto Rico, Maryland and Maine/New Hampshire -- have raised their commitments by a total of $357,000.

Throughout the history of the program, matching funds have invariably exceeded the required minimum. In fact, over 40% of the program is currently supported from matching funds. Let me cite a few examples which illustrate the essentially local significance of the program and the local resources available to continue it.

Over the years, Sea Grant has helped a number of universities initiate or improve curricula in marine studies. At the University of New Hampshire, Sea Grant has supported an ocean projects course which gives undergraduate students the opportunity for hands-on experience in marine research. Sea Grant-sponsored investigators at MIT are cooperating with teachers in the New Bedford Public School System to develop a series of new textbooks called "The World of Water." Sea Grant financed Project Coast at the University of Delaware, whose teaching materials have been adapted for use in secondary schools in a number of coastal states. At the University of North Carolina, Sea Grant helped students participate in research projects in ocean and coastal law which proved useful to state agencies.

Recognizing that much education takes place outside the classroom, Sea Grant has supported informal education in a number of states. Sea Grant helped design and install a marine exhibit at the Roger Williams Museum in Providence, Rhode Island. The museum offers teacher training in marine studies. In Florida, Sea Grant sponsored development of a 4-H marine education program which needs no further Federal assistance.

From its inception, Sea Grant has pushed for training programs at vocational and technical schools. At Clatsop Community College in Oregon, Sea Grant is supporting the development of training for working fishermen, arranged to fit their busy schedules. At the University of Rhode Island, Sea Grant sponsored the start-up of a commercial fisheries training program, which now continues without Federal funds. Sea Grant also helped initiate programs in diving technology at the University of Michigan, Santa Barbara Community College and the Florida Institute of Technology.

To reiterate, these activities are useful, but they are essentially local or regional in importance.

The Federal government has certainly done its part to develop marine resources. Fifteen years of carefully targeted effort have paid off in programs of practical benefit to countless communities and local enterprises. Now the time has come for us to back off and let state and local governments and the private sector take up the slack. And that, in fact, is exactly what is happening.

Let me cite just four typical examples of matching funds provided by the private sector.

-- The CBS radio station in Los Angeles donates air time worth $100,000 per annum for broadcasts of marine weather information prepared by the University of Southern California Sea Grant Program.

-- Genetic and diet studies of pen-cultured Coho Salmon at the University of Washington were financed by DomSea Farms, a commercial grower, to the extent of $90,000.

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- -- Grumman-Allied Industries gave equipment and services valued at $23,000 to help the University of Rhode Island study methods to extend the storage life of fresh fish.
- -- The Technology Transfer Program of the Massachusetts Institute of Technology Marine Industry Advisory Service is subsidized by $86,900 in matching funds provided by 100 industries.

The total of all such private support is $2,713,700.

Clearly, no Sea Grant activity is inherently Federal in character, and none can make a rational claim upon the Federal budget in a time of severe fiscal constraints. In general, the most productive and useful Sea Grant programs will be picked up and developed further by the private sector.

Mr. Chairman, this concludes my statement. I would be happy to answer your questions or the Members'.

Senator PELL. Thank you very much, Mr. Winchester. Did NOAA, your agency, submit a fiscal 1984 budget request to Commerce, to your superiors, to continue the sea grant program?

Mr. WINCHESTER. Yes, sir, Mr. Chairman, we did submit, as I recall, a budget for something like 1.7 million. Something like that was submitted to the department for the purpose of phasing out the program. We wanted a little cushion of money to phase out those things that might be more difficult to phase out without some additional money.

Senator PELL. In making your recommendation, did you have the benefit of an analysis of the benefits of the sea grant program? In other words, do you have any idea of the cost/benefit from it? As you know, the emphasis in sea grant is to take applied research—not basic research—applied research and translate that knowledge into dollars.

Mr. WINCHESTER. We have never made an analysis of the sea grant program in its entirety. We have made an analysis of specific projects within the program. And we are not really contending that the sea grant is not a productive program in terms of cost/benefits or that it is not a good program.

Our analysis did show that sea grant had been a cost-effective program in terms of cost/benefit ratios. But our rationale is based simply on the fact that we have a finite number of dollars in NOAA to operate within, and we felt that there were some other things that were of higher priority than sea grant. That was our rationale.

Senator PELL. My recollection was that at one point the sea grant program—maybe Mr. Wildman would be familiar with this—had made a study of the cost/benefits of the sea grant program.

Do you recall such a study being made?

Mr. WILDMAN. We funded a project at MIT a number of years ago to look at some of the programs that we were funding, and we also supported a followup study last year which again looked at some of those same programs in terms of longer term payoff.

Senator PELL. What were those figures, very roughly?

Mr. WILDMAN. Well, in the followup study 19 projects were looked back on and they projected sales now of something like $40 to $60 million. Because of the indefiniteness of some of the data, that is about as close as they could come. But that again is just for a limited number of projects that were funded in the 1975-1976 period.

Senator PELL. That is right. There were about maybe 20 projects that were examined using a benefit of $35 or $40 million, but the total number of projects went into the hundreds.

Mr. WILDMAN. In the thousands.

Senator PELL. So you could say the cost/benefits would go into the hundreds of millions of dollars already out of this program. Would that be a correct statement?

Mr. WILDMAN. That is possible, but of course without going into a real analysis of all of them, it would be hard to say just what that number would be.

Senator PELL. Right. I remember when the administration first proposed extinguishing this program—and it was very interesting because I think it was the Heritage Foundation had recommended this program should be one of those that should remain in place because of its cost/benefit. It was these arguments, I think, that played a very real role in the continuation of the program, both here on this end of Pennsylvania Avenue and also, I think, encouraging your people to be not quite so vigorous in their opposition to it.

When one realized what the cost/benefit was, the dollars that were returned to industry and even the dollars that were returned to Uncle Sam in the form of additional taxes, and this is all, I think, a factor to be borne in mind.

Now, I was struck, Mr. Winchester, that you portrayed sea grant as primarily a regional program. It plays a national role in such services as aquaculture, marine pollution, extension services, and things of that sort.

Do you not think basically that there may be some regional aspects, but in general the projects have national application, not just regional application?

Mr. WINCHESTER. Mr. Chairman, I think it has some of both, and I believe the examples you gave, I would consider national. But I—my own opinion is that the majority of the projects funded by sea grant provide economic benefits to local areas much more than they do the national economy. Of course, that helps the national economy, obviously, if you benefit local areas.

But, for example, some of the types of projects that sea grant has funded and projects that have been very successful are projects that assist small businessmen and local and State governments in making better uses of their marine resources. We do not have anything except good words to say about the success of the sea grant program. It is strictly a matter of a management judgment that within the dollars that we have to spend, there are other things of higher priority than the sea grant, and we still maintain that if the Federal Government should terminate its funding to sea grant, the program certainly will not stop in its entirety, in our opinion.

I testified 40 percent of sea grant support now comes from other than Federal funds. That is more than required by the legislation, and we actually feel that if the Federal Government should terminate funding, that percentage would increase, and also some of the research that is being now pursued under sea grant funding would be picked up by other sources. Some might even be picked up by other organizational elements, within NOAA.

Senator PELL. But do you not think the reason for the successful cooperation now in the work that is being done is because of the involvement of the local governments and the Federal Government and the educational institutions and private industry; that if you knock out any one of these four partners, you then find that the project will be less effective.

If a cart is being drawn by four horses and you knock one horse out, it is not going to go as well.

Mr. WINCHESTER. Well, obviously, I cannot give anything that I would consider a definitive answer to that, but I think it might even help bring more local support if by the Federal Government terminates funding. As long as the Federal Government funds something, there are people who will let it happen.

Senator PELL. This has certainly not been the experience with other programs that the Federal Government has terminated, as seen under the oversight of this committee, whether it is in arts and humanities, in education, or even humanitarian programs, I do not find localities and private industry taking up the slack from the cutting back of the school lunch program, and things of that sort.

Mr. WINCHESTER. Well, I guess I would suggest that there might be a different motive. The sea grant program has made an economic contribution to the local areas by helping small businesses and small industries and helping to protect their local resources. So I think there is some economic incentive on the part of the local businesses and local communities to keep it going.

Senator PELL. Well, do you not think that if we follow the administration's counsel, that what would result would be that the local institutions would really focus entirely on their local and regional problem.

For example, the University of Rhode Island is involved in several national programs under sea grant, not local, not State. If Federal support gets eliminated, how could they be encouraged, what would be the incentive for them to focus on national programs instead of strictly dropping their sights and focusing only on the local programs?

Mr. WINCHESTER. I suspect that is true. I think I would agree with that, but as I mentioned briefly a minute ago, we believe that if the Federal Government should terminate its funding under the sea grant program, some other avenues to funding of universities or research other than sea grant might very well open up.

In other words, NOAA now funds universities. I believe in 1982 our total funding of universities other than sea grant was about $26 million or $27 million a year. That is an increase from about $5 million a year in 1976.

Actually in our 1984 budget, we expect, though the total budget submission was less than 1983 and 1982, that there will be some increases to universities in general.

Now, I cannot sit down and specify which universities, but we believe that there will be some increase in funding to universities from NOAA.

Senator PELL. From where?

Mr. WINCHESTER. From NOAA. As I mentioned, NOAA funded universities last year, 1982, at about $26 million. We believe in 1984, 1985 and outyears NOAA will probably fund universities for a total of that much or more in spite of a decrease in our total budget.

Senator PELL. So that is no increase. In other words, you are saying there will be level funding.

Mr. WINCHESTER. Well, I said that much or more, and we actually have in our plans now for some additional funding to universities in 1984 and 1985 and 1986.

Senator PELL. Well, what are those plans? What are those projections?

Mr. WINCHESTER. As part of our climate research and ocean climate research program, we have a budget increase of $2.5 million. We expect about $1 million of that to go to universities. That is additional money. That is in 1984.

Senator PELL. So that $1 million is supposed to take up the slack of the withdrawal of the $40 million?

Mr. WINCHESTER. I am not saying, Mr. Chairman, that it would equal out, but I am saying it is not as bad as it might sound because we do not believe that if the Federal Government should terminate funding of sea grant all the research at the universities will suddenly stop. We do not believe that.

Senator PELL. Obviously, if you eliminate the program, one of the casualties would be the Marine Extension Service. Well, if you eliminate the Marine Extension Service, how could the information, like those currently supported by sea grant, the results of the program, how could that be shared, distributed around the country?

Mr. WINCHESTER. Well, I guess I have not tried to think specifically if the sea grant program were terminated exactly what parts of it local government and industry would pick up and what parts might be picked up by some other Government source.

But I do not believe there is any doubt in anybody's mind that the Marine Advisory Service is an important part of sea grant, I also believe that it would be one of the services that the local governments would probably want to pick up because it is just as important to them, or more important to them, as it is to anybody else to translate research results into solving operational problems. I might also say that some of the plans we have in our reorganization of NOAA in the outyear programs reflect that NOAA as a governmental agency is interested in some kind of a Marine Advisory Service because we feel very strongly that our services and what we have to offer does not get out into the hands of the general public as well as it should.

Senator PELL. Certainly, the Marine Extension Service now does a pretty good job in making its material available. Well, if you eliminate the sea grant program, you eliminate the marine extension program right there. So it means that the results of the local efforts in, say, the State of Washington or the State of Rhode Island will not be made available around the country.

Mr. WINCHESTER. Well, I do not know if I would completely agree with that.

Senator PELL. Well, where would you disagree with it?

Mr. WINCHESTER. Well, as I said, I believe there will be other sources of funding to help carry on some of the Marine Advisory Services.

Senator PELL. Let us be specific. The Marine Extension Service, what other source would come in to help it along?

Mr. WINCHESTER. Well, I certainly believe that some of the local funding would go to supporting a Marine Advisory Service. I also mentioned, I believe that NOAA particularly has determined that we have needs for more advisory services, if that is the right term, than we are providing; so some of our sources might go in to continuing it.

I am speculating. I do not have anything definitive to offer in terms of number of dollars and where they would go, but I think the overall program plans are that some of those things would be carried on.

Senator PELL. Well, I think you will be a magician if you eliminate the means and then some way or other it would carry on. Certainly, Rhode Island has no great desire to spend money to help the State of Washington, or vice versa. I think that there has to be some national program here. But I realize that you are here to carry out the wishes of the administration, and you represent them to the best of your ability.

I am deeply disappointed to see for the third year in a row that the administration is trying to knock out a program that many of us in Congress think has proved itself and done a good job. We appreciate the administration's thoughts, and whatever action we take, we will take into account your recommendations and thoughts.

Thank you very much, Mr. Winchester, for being here with us, and Mr. Wildman, thank you.

Mr. WINCHESTER. Thank you, Mr. Chairman. We were very pleased to appear.

Senator PELL. Our next witness is my old friend, Dr. John Knauss who is Chairman of the National Advisory Committee on Oceans and Atmosphere, and also provost of the University of Rhode Island in its sea grant program.

I think I got the title wrong. Excuse me.

STATEMENT OF JOHN A. KNAUSS, CHAIRMAN, ADVISORY COMMITTEE ON OCEANS AND ATMOSPHERE, WASHINGTON, D.C.

Mr. **Knauss**. My title keeps changing, Mr. Chairman. I think I am a vice president, marine programs, today.

Senator, I am very pleased to appear before you today on behalf of the National Advisory Committee on Oceans and Atmosphere, NACOA.

Although my statement is quite brief, it is still not brief enough to get through in 5 minutes, so I will try to summarize the statement itself.

We are here to present our views on the reauthorization of the national sea grant college program. On a more personal note, I am particularly pleased to address this committee on sea grant because it was some 18 years ago I called the first national conference on the sea grant concept in Newport, R.I., a conference at which you appeared as an active participant, and which led to the passage of the sea grant legislation which we are here to discuss today.

Senator **Pell**. Both of our hairs were different colors 18 years ago. [Laughter].

Mr. **Knauss**. The sea grant program has been the subject of NACOA consideration several times in the past. In November 1976, for example, NACOA completed an extensive study of sea grant, resulting in a strong recommendation that the program be continued.

Because sea grant reauthorization is required by fiscal year 1984, NACOA recently reviewed the effectiveness and benefits of sea grant to determine whether its contributions to solving national ocean problems and to developing marine resources warranted its continuation.

We at NACOA received presentations from a variety of sources on sea grant marine advisory services, research applications, industrial interaction, educational values, and contributions to the commerce economy.

Our review was conducted by an entirely different membership from the NACOA committee that did the 1976 report. I might note parenthetically, Mr. Chairman, it was also a much more conservative group of NACOA members than were the NACOA members of 1976.

I am pleased to state that the conclusions reached by the current NACOA membership reaffirm the 1976 NACOA position that the sea grant program is a unique national asset which should be preserved to foster the development of our Nation's marine resources.

Our March 8, 1983 statement of support for the national sea grant program is appended. I will not review this document in detail, but I will be pleased to respond to any questions you may have on it.

Let me summarize briefly our reviews on the value of sea grant on one issue of particular relevance to this committee; that is the providing of an educated work force. We believe it is essential to our country's future activities in the ocean.

Even the casual observer of ocean activities must recognize the enormous changes that have taken place in recent years in the way in which our Nation regards the ocean. Events clearly indicate that the U.S. ocean interest will continue to accelerate and change in the years ahead.

sea grant institutions engage the interest of a marvelous array of multidisciplinary talents, students and faculty in conducting their programs. Moreover the sea grant institutions are organized in a network with experience, knowledge, and problem solving capabilities and problem solutions in one institution are available to all other sea grant institutions and memberships of the partnership: Federal, State, and local governments, academia, the private sector.

Many of the students benefiting from sea grant education and training in the marine sciences, engineering, and technology can be traced to positions in the private sector where they are continuing to apply the principles of the sea grant interdisciplinary and realistic approach to the resolution of ocean issues.

NACOA believes sea grant training and education activities are a sound, blue chip, long term investment for this Nation. Let me comment briefly on the reauthorization of the sea grant program. Because of the present fiscal constraints and consequent reduction in Federal appropriations, many of the sea grant colleges and institutions have been faced with an eroding support base with which to fund programs needs and opportunities.

Concurrently, all States, including the coastal and Great Lakes States, are experiencing increasing budget problems as more and more programs once supported by the Federal Government are being shifted to the states.

Sea grant is caught up in this web of both the Federal and State levels of support, and without Federal support, it is unlikely that the States will be able to carry on the task.

We recognize at NACOA the present fiscal constraints mandate short-term belt tightening. Sea grant appropriations over the past 2 fiscal years reflect this budget policy. However, NACOA firmly believes sea grant is a valuable national asset that has contributed significantly to the development of our Nation's marine resources and is worthy of continued funding at levels to maintain its effectiveness.

NACOA strongly recommends that reauthorization be a clear statement of support for the completion of the sea grant network and subsequently for the continuation of the network system.

We support a multiyear reauthorization of sea grant programs; a stable and assured level of support is important to assure that the excellence of sea grant faculty and students and thus in research products remains a hallmark of the program.

It is difficult to put faith and energy into a program that is bouncing up and down from year to year. The fiscal uncertainties of the past few years have jeopardized the scientific talent associated with the sea grant community and have required inordinate expenditures of time in the funding process.

Many sea grant researchers have elected to leave, presumably for a more stable work environment. It is difficult to develop sound, long-term programs when the future of a program is as uncertain as sea grant has been for the past 3 years.

A multiyear reauthorization will provide a signal to the sea grant community that is both positive and responsive to the national effort directed toward the development of our resources.

NACOA recommends reauthorization of at least 5 years. We also recommend that the funding authorized be adequate to operate a complete sea grant network with a major sea grant program in each coastal and Great Lakes State. Presently, the major, well developed sea grant college programs, each compete successfully for about $2 million per year. Based on this figure, the number of coastal and Great Lakes States, which are 30, NACOA believes that a $60 million authorization figure is not unreasonable.

Thank you, Mr. Chairman. That completes my statement.

[The prepared statement of Dr. Knauss follows:]

STATEMENT
by
Dr. John A. Knauss, Chairman
National Advisory Committee on Oceans and Atmosphere*
before the
Subcommittee on Education, Arts and Humanities
Committee on Labor and Human Resources
United States Senate

April 7, 1983

Mr. Chairman and Members of the Committee, I am pleased to appear before you today on behalf of the National Advisory Committee on Oceans and Atmosphere (NACOA) to present our views on the reauthorization of the National Sea Grant College Program. On a more personal note, I am particularly pleased to address this Committee on Sea Grant, because some 18 years ago I called the first national conference on the Sea Grant concept in Newport, Rhode island -- a conference in which Senator Pell was an active participant and which led to passage of the Sea Grant legislation we are here to discuss today.

The Sea Grant program has been the subject of NACOA consideration several times in the past. In November 1976 for example, NACOA completed an extensive study of Sea Grant resulting in a strong recommendation that the program be continued. The Committee concluded that...

> Sea Grant plays a unique and valuable role in the Federal effort directed toward marine resource development, characterized by its ability to draw on the talent and expertise in a wide variety of fields found primarily in the Nation's universities and research institutions, and by its ability to direct this talent toward the solution of practical problems faced by industry and government in their efforts to develop and regulate the use of marine resources.

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*The National Advisory Committee on Oceans and Atmosphere (NACOA) is a non-Federal, 18-member body, appointed by the President. Members represent industrial, scientific, and environmental concerns associated with marine, atmospheric, and coastal zone policy. Enabling legislation (Public Law 95-63) mandates that NACOA advise the President and Congress on these matters.

Because Sea Grant reauthorization is required by fiscal year 1984, NACOA recently reviewed the effectiveness and benefits of Sea Grant to determine whether its contributions to solving national ocean problems and to developing marine resources warranted its continuation. We received presentations from a variety of sources on Sea Grant marine advisory services, research applications, industrial interactions, educational values, and contributions to commerce and the national economy.

Our review was conducted by an entirely different membership from the NACOA Committee that prepared the 1976 report. I am pleased to state, Mr. Chairman, that the conclusions reached by the current NACOA membership reaffirm the 1976 NACOA position that the Sea Grant program is a unique national asset which should be preserved to foster the development of our Nation's marine resources. Our March 8, 1983, statement of support for the National Sea Grant Program includes several suggestions for improving the program and is appended to this testimony. Although I will not review this document in detail, I will be pleased to respond to any questions you may have on it.

I will, however, summarize briefly our views on the values of Sea Grant for providing the educated workforce we believe is essential to our country's future activities in the ocean.

Even the casual observer of ocean activities must recognize the enormous changes that have taken place in recent years in the way in which our Nation regards the ocean. Events clearly indicate that U.S. ocean interest will continue to accelerate and change in the years ahead, particularly in many important areas of concern, such as food supply, offshore energy development, environmental protection, and even in the role of the oceans in the basic foreign policies of the United States. I know this Committee is aware of this and I will not belabor the point. We now manage fisheries in a 200-mile Fishery Conservation Zone, we are increasingly concerned about the issues of coastal zone management, offshore oil and gas development continues to grow, we are promoting deep seabed mining, and we are modifying policies to allow reasoned disposal of wastes at sea. We have recently completed 10 years of negotiations for a Law of the Sea treaty that will guide the ocean activities of most of the world outside the United States, and we now have a Presidential Proclamation establishing a U.S. Exclusive Economic Zone -- a pronouncement of considerable significance. The United States will need a larger workforce trained to deal with complicated interrelationships and ocean use conflicts. These individuals must be capable of understanding and dealing coherently with scientific, technical, legal, social, regulatory, economic, and commercial issues and problems. This is the basic strength of the Sea Grant program and its unique value to the country -- the provision of a much needed, educated workforce to address marine related issues now and in the future.

Sea Grant institutions engage the interests of a marvelous array of multidisciplinary talents -- students and faculty -- in conducting their programs. Moreover, the Sea Grant institutions are organized in a network where the experience, knowledge, and problem solving capabilities and problem solutions in any one institution are available to all other Sea Grant institutions and members of the partnership--Federal, State, and local governments, academe, and the private sector.

Many of the students benefiting from Sea Grant education and training in the marine sciences, engineering, and technology can be traced to positions in the public and private sectors (including Congress) where they are continuing to apply principles of Sea Grant's interdisciplinary and realistic approach to the resolution of ocean issues for the benefit of our citizens. NACOA believes Sea Grant training and education activities are a sound, blue-chip, long-term investment in the preparation of our Nation's future marine developers, regulators, and administrators.

I will comment briefly now on reauthorization of the Sea Grant program. Because of the present fiscal constraints and consequent reduction in Federal appropriations, many of the Sea Grant Colleges and institutions have been faced with an eroding support base with which to fund program needs and opportunities. Concurrently, all states including the coastal and Great Lakes States are experiencing increasing budget problems as more and more programs once supported by the Federal Government are being shifted to the States. Sea Grant is caught up in this web at both the Federal and State levels of support. Without Federal support, it is unlikely that States will be able to carry on the task.

We realize present fiscal constraints mandate a short-term "belt-tightening;" Sea Grant appropriations over the past two fiscal years reflect this budget policy. However, NACOA firmly believes Sea Grant is a valuable national asset that has contributed significantly to the development of our Nation's marine resources and is worthy of continued funding at levels to maintain its effectiveness. NACOA strongly recommends that reauthorization be a clear statement of support for the completion of the Sea Grant network and subsequently for the continuation of the network system. We support a multi-year reauthorization for the Sea Grant program. A stable and assured level of support is important to assure that the excellence in Sea Grant faculty and students, and thus in research and product, remains a hallmark of the program. It is difficult to put faith and energy into a program that is bouncing up and down from year-to-year. The fiscal uncertainties of the past few years have jeopardized the scientific talent associated with the Sea Grant community and have required inordinate expenditures of time in the funding process. Many Sea Grant researchers have elected to leave, presumably for a more stable work environment.

It is difficult to develop sound, long-term programs when the future of the program is as uncertain as Sea Grant's has been the past three years. A multi-year reauthorization will provide a signal to the Sea Grant community that is both positive and responsive to the national effort directed at the development of our marine resources. NACOA recommends a reauthorization of at least 5-years.

We also recommend that the funding authorized be adequate to operate a complete Sea Grant network with a major Sea Grant program in each coastal and Great Lakes State. Presently, the major well-developed Sea Grant College programs each compete successfully for about $2.0 million per year. Based on this figure and on the number of coastal and Great Lakes States (30), NACOA believes a $60 million authorization figure is not unreasonable.

I thank the Chairman and members of the Committee for the time and opportunity to present NACOA's views and recommendations on Sea Grant reauthorization. I will be pleased to respond to any questions the Committee may have.

NATIONAL ADVISORY COMMITTEE
ON
OCEANS AND ATMOSPHERE
3300 Whitehaven Street, N.W.
Washington, DC 20235

March 8, 1983

NACOA Position Statement on the National Sea Grant Program

Historically, the National Advisory Committee on Oceans and Atmosphere (NACOA) has been a strong supporter of the National Sea Grant College Program. For this reason and because the Sea Grant program is scheduled for Congressional reauthorization in the Spring of 1983, NACOA has conducted a review on the effectiveness and benefits of Sea Grant. As a result of this review, NACOA reaffirms its belief that the Sea Grant program is a unique national asset which must be maintained to foster the development of our Nation's marine resources.

Sea Grant has contributed significantly to the management, wise use, and protection of our Nation's marine resources. A number of recent studies have measured these contributions in terms of their economic significance. The results of these studies conclude that the Sea Grant program operates in a highly cost-efficient manner producing economic benefits an order of magnitude greater than the annual financial investment in the program. Moreover, the program has been cited by Congressional committees, the Heritage Foundation, and others as one of the most effective programs of the Federal Government.

Much of Sea Grant's effectiveness can be attributed to the conceptual framework within which the program was established in 1966 -- a partnership among State and Federal governments, universities, and private industries. Collectively, the partnership arrangement provides a comprehensive research and development effort that is focussed on development of marine resources through a national network of universities and institutions of higher learning. The national network orientation of the program is essential to provide educational, research, and advisory services that embrace a broad array of marine scientific, engineering, and commercial activities. Furthermore, the Sea Grant network serves as a "transmission belt" that transfers information and technology to the user community. In turn, this transmission belt relays problems experienced by the user community to Sea Grant practitioners for research or development.

NACOA believes the Sea Grant program is responsive to the Congressional mandate that established the program. Contemporaneously, NACOA also believes that several structural elements of the Sea Grant program require a reorientation toward recent trends in ocean science. Specifically, these program elements include the national and international programs, and the participation of the private sector in Sea Grant research activities. These elements are discussed below.

National Projects Program

In 1976, the National Sea Grant College Program Act was amended to provide, among other things, a separate appropriation for the support of marine resource projects that were national in scope. The primary purpose of this objective was to "identify specific national needs and problems with respect to ocean and coastal resources ... [and] enter into contracts ... with respect to such needs and problems." NACOA supports the concept of this national project provision and believes it is an important aspect of the Sea Grant research program. However, the Committee also believes that this particular element of the Sea Grant program has not developed in the manner in which Congress intended.

Many of the projects in the Sea Grant national program focus on problems in a generic sense at various Sea Grant institutions around the country. In effect, the national Sea Grant program office identifies a specific national problem, such as marine corrosion, that should be addressed and investigated by Sea Grant institutions. Proposals from institutions are then independently transmitted to the Sea Grant program office for review and approval. As a result, many of the national projects are not necessarily coordinated between institutions or within the Sea Grant network. This program management approach does not encourage nor promote the Sea Grant institutions to blend their available resources and various areas of expertise on broad problems of national importance or of major regional importance to many states.

NACOA believes that the overall strength of the national projects program can be improved with unified planning for developing major projects to investigate national problems within geographical regions (for example the New York Bight, Gulf of Mexico, Great Lakes, Puget Sound, etc.). Such an approach will encourage Sea Grant institutions to join together to focus on broad problems that transcend coastal state boundaries as well as problems of national importance to the United States in a more effective manner.

Sea Grant International Program

The Sea Grant International Program (SGIP), like the national projects program, was established by the National Sea Grant College Improvement Act as a separate appropriation. The original objectives of the SGIP are to 1) "enhance the research and development capability of developing foreign nations with respect to ocean and coastal resources," and 2) "promote the international exchange of information and data with respect to the assessment, development, utilization, and conservation of such resources."

The first objective overlaps with functions of the Aid to International Development (AID) program. In fact, AID has provided some support through the Sea Grant International Program for the provision of marine technical assistance activities with third world nations. If the Federal Government believes that this activity is important to its foreign assistance interests, then it should be supported. If not NACOA recommends that the Sea Grant program deemphasize the AID approach of the SGIP program.

Instead, Sea Grant should accelerate and promote activities related to the second program objective, the cooperation and exchange of marine information with all coastal nations. While we should not slight the opportunities and benefits of scientific cooperation with less developed countries, neither should we avoid cooperative arrangements with nations that have developed marine scientific skills which match our own. In this way we provide maximum benefit to ourselves and all other coastal nations.

Industry Participation

Colleges have served as the primary base for Sea Grant research, education, and advisory services. Despite this primary research relationship, any institution, agency, or industry, public or private, is eligible to receive support from the Sea Grant program, provided it submits a research proposal and meets the match funding requirements mandated by the Act. In the course of our review, we discovered that direct participation in Sea Grant research by private industry is virtually zero. NACOA believes that this situation is a waste of a vast resource pool which could be drawn upon to assist in the development of our ocean and coastal resources. Moreover, the private sector could benefit from the expertise available within the Sea Grant community. A Sea Grant objective to increase private sector participation in Sea Grant research should be a directed, priority effort; it could foster new investment, develop new markets, and stimulate new industry.

Reauthorization

The primary purpose of the Sea Grant program is the development of a network of colleges and institutions of higher learning in the coastal and Great Lakes states to "achieve the gainful use of marine resources" through a partnership between the Federal and state governments, universities, and the private sector. The tripartite partnership is essential to complete the Sea Grant network system. More specifically, continued Federal participation in the partnership is critical to the development and continued operation of a complete Sea Grant network.

Due to the present fiscal constraints and consequent reduction in federal appropriations, many of the Sea Grant Colleges and institutions have been faced with an eroding support base with which to fund program needs and opportunities. At the same time, most of the coastal and Great Lakes states and universities are experiencing budget problems as more and more programs that have been supported by the Federal Government are being shifted to the States. The result of this eroding support is that the Nation will not receive the significant contributions that Sea Grant is capable of making in the development of our marine resources. Positive action is needed to halt this erosion.

Moreover, the Committee recommends that the level of authorization be based on the funding necessary to operate a complete Sea Grant network, or, a major Sea Grant program in each coastal and Great Lakes state. Presently, the major, well developed Sea Grant College programs each compete successfully for approximately $2.0 million per year. Based on this figure and by factoring in the total number of coastal and Great Lakes states in the Nation (30), NACOA believes that a $60 million authorization figure is not unreasonable to operate a completed Sea Grant network today, when one considers the demonstrated benefits and future potential of the program.

NACOA realizes that present fiscal constraints mandate a short-term "belt-tightening" and that Sea Grant appropriations over the past two fiscal years are a reflection of this budget policy. However, NACOA also firmly believes that Sea Grant is a valuable national asset that has contributed significantly to the development of our Nation's marine resources and worthy of continued funding. NACOA strongly recommends that authorization be a clear statement of support for the completion of the Sea Grant network and subsequently, for the continuation of the network system.

Furthermore, NACOA recommends that the reauthorization be for a multi-year period. We put forward this recommendation for several reasons. First, a stable and assured level of support is important to assure that the excellence in faculty and students, and thus in research and product, that are presently associated with Sea Grant remain with the program. It is extremely difficult to put faith and energy into a program that is bouncing up and down from year to year. The fiscal uncertainties of the past few years have jeopardized the scientific talent associated with the Sea Grant community and have required inordinate expenditures of time in the process; many Sea Grant researchers have elected to leave for, presumably, a more stable work environment. A multi-year reauthorization will provide a signal to the Sea Grant community that is both positive and responsive to the national effort directed at the development of our marine resources.

Secondly, research and education are activities that require leadtime for review of proposals and for planning purposes. An authorization of at least 5 years would provide the necessary span of time needed for effective planning.

In addition to our recommendations on the specific Sea Grant program elements discussed above and our views and recommendations concerning program reauthorization, NACOA believes that any revisions to the National Sea Grant College Program Act should preserve the foundation that has made the program successful. These include maintenance of the Sea Grant network and the "targeted" research approach to development of ocean and coastal resources, and continuation of the federal and congressional oversight process. Maintenance of the federal role and partnership in the Sea Grant program ensures the wise use, development, and conservation of our Nation's common property marine resources, and provides coordination of the program on a nationwide basis. Congressional oversight is essential for ensuring that the effectiveness of Sea Grant is weighed against the ocean elements that affect the national economy, security, and public well-being of our country.

Senator PELL. Thank you very, very much indeed, Dr. Knauss. Then the recommendation—the bill that we have introduced which calls for funding of $40 million the first year, $45 the second, $50 the third, and then $5 million each year for the international program, in your view that is not adequate to do the job that you believe should be done.

Mr. KNAUSS. We recognize, Mr. Chairman, that there is always a difference between what is authorized and what is appropriated, but the previous sea grant authorization bill was closer to $60 million, and we do believe that the authorization level should be such that it would complete the sea grant network so every coastal and Great Lakes State could look forward to having a major sea grant program.

We would hope in time the appropriation would be able to meet that authorization level as each State develops its program.

Senator PELL. Personally, I would agree with you, but as you know, we have to reach a compromise, and that is the reason for these figures that, to my mind, are adequate, that we have advanced.

Your testimony recommends, too, a larger trained work force is going to be necessary to deal with all the ocean related conflicts in the future. I wonder how you believe that marine oriented personnel would be trained if the sea grant program is wiped out?

Mr. KNAUSS. There is at least one point in Mr. Winchester's statement which I do agree in, that universities are not going to stop their marine activities completely if there is no sea grant program. But I am also very much convinced that the level of education, the level of research, the kinds of research and educational activities will be much reduced, and I do not think will be adequate to the task. And you know better than most, Senator Pell, that the activities, the opportunities, the problems in the oceans are continuing to grow and will continue to grow, and I think we must work very hard in our universities to develop the educated personnel to deal with those matters.

Senator PELL. I am reminded here of the ocean affairs program at our own university. And I recall one of your students, my son, who graduated in that program. And it started, if my recollection is correct, because of the sea grant program; although the financing of it is now undertaken by the university; is that correct?

Mr. KNAUSS. That is correct. When we started the matter of marine affairs program at the university we used sea grant funds over the first few years to help develop that program and to maintain it. And sea grant still indirectly supports some of the efforts of that program.

Senator PELL. Now, I noticed in the position of NACOA on the national sea grant program, you mention in the second paragraph that a number of recent studies have measured the contribution in terms of economic significance.

Do you have any thoughts as to the cost benefit ratio of the dollars spent in the sea grant program, what that produces in both the return to private industry and eventually taxes to the Government?

Mr. KNAUSS. NACOA did not make an independent evaluation, Mr. Chairman. We listened to the statements that were made by Professor Corell of the Sea Grant Association. We listened to the numbers brought forward by, I think it was, Mr. Utterback from MIT, the statement that Bob Wildman referred to in his testimony. Nobody has done a complete study of the entire sea grant network. It would extraordinarily difficult and expensive thing to do.

But certainly based upon the individual studies that have been made—and sea grant programs themselves have done a number of these cost benefit studies, and we at the University of Rhode Island have done several. I think it is quite clear that the cost benefit of this program is good; whether it is 5 to 1 or 20 to 1, I am not prepared to argue. But it certainly is well over 1 to 1.

Senator PELL. And then also there is a return that cannot be measured in dollars. I was reading in the Providence Journal awhile back about the story of some fishermen who were swept over the side of their vessel when their vessel flounded, and they survived. Why? Because they had recently had a course at the University of Rhode Island on survival in cold, thermal survival.

Could you refresh my memory on that?

Mr. KNAUSS. That is right. It is one example of a so-called local or regional program which has had national significance. We ran a small educational program, if you will, on hypothermia, and what was necessary to survive in cold water.

As a direct result of that—at least an indirect result of that conference, local fishermen have made use of the new hypothermal suits, techniques they have learned, and, yes, we can point to at least one life, maybe several lives that I think have been saved because of this information.

Furthermore, this conference and the information that was generated at the University of Rhode Island has been used not just in Rhode Island, but it has been used nationally.

Senator PELL. I cannot help but think back to World War II when I remember being on convoy duty and we picked people up sometimes in the ocean, and if we had had the benefit—if they had had the benefit of those courses, we might have picked up live people instead of an occasional corpse.

Mr. KNAUSS. As a part of that program, I went out in one of those suits. I can assure you I would feel quite comfortable staying in the ocean for some time under those circumstances.

Senator PELL. Now, you testified also that the sea grant college program is a network, not really regionally based or a locally focused organization. Could you elaborate a little bit on that? What are the relations of sea grant with, for example, the University of Washington or with the Great Lakes.

Mr. KNAUSS. Well, the network is many faceted. There is the Sea Grant Association and its network of individuals which meet regularly, exchange information, exchange ideas. That is one part of the network.

There is also what I would call the research network. If we, for example, develop a finite element model to do a numerical study of the circulation of Narragansett Bay, the techniques that are developed for that model clearly can be applied, and have been applied, to other estuaries up and down the coast.

Studies that we or others do on marine pollution in the Narragansett Bay—the techniques we develop, and so forth, are applicable to those who are studying similar types of problems in the Chesapeake Bay, for example, and vice versa.

We learn from our peers at other universities, and they learn from us. So it is indeed a national network.

Senator PELL. You also focused our attention on the problem of the researchers who are leaving the field because of fiscal uncertainties. What will be the effect also on the management team that we have today in the different universities? Will they also be dissolved if this program is extinguished or do you think private industry or local government will take up the slack and take them on?

Mr. KNAUSS. If the program is dismantled, of course these management teams will be dissolved as will the researchers—they will go elsewhere. I think the thrust of my testimony, however, was the concern I have that people get tired; they get discouraged.

Good researchers and good managers will go where there is less hassle, less difficulty of getting funds to do their research. And I am concerned that the quality of the management of sea grant or the quality of the researchers who are attracted to sea grant, the quality of the people who are involved with the Marine Advisory

Services will decrease if the—unless a strong message is sent, either by the administration or by Congress—preferably by both—that they believe that sea grant is an important program and one that can look forward to, hopefully, a stable and long and successful future, as well as its successful past.

Senator Pell. Let us look at the specific case—and you and I were both midwives at its birth. Taking wearing your hat as vice president for ocean affairs at the University of Rhode Island—I hope I have the title straight now—what would be the effect on our university if the sea grant program was wiped out?

Mr. Knauss. Well, there is about $1.5 million Federal dollars that come to the University of Rhode Island through the sea grant program. Some of those programs, if we scrambled, we might be able to find funding for from other sources within the Federal Government.

But there are a number of programs which are unique to sea grant which are very difficult to find funding for elsewhere. And the Marine Advisory Service is certainly one of them.

Therefore, I do not believe it would be possible to find substitute Federal support for a large number of the programs that are in sea grant.

Furthermore, I do not think I have to tell you anything about the economy of Rhode Island; it is very unlikely that the State government and certainly the University of Rhode Island is going to be able to move quickly—resources to cover those programs which are no longer being supported. As you pointed out, the Federal Government has put an increasing burden on the States to pick up one program after another. And although Rhode Island is the Ocean State and Narragansett Bay and the oceans are very important to Rhode Island, I do not care to contemplate the problem that Governor Garrahy and others will have if it is a question of supporting continued marine activities or providing the funds necessary for—welfare services and health services and those kinds of things which are also being thrust upon the State. So I think it would be very difficult for the State to pick up these services.

We may get some increased support from private industry. But I do not believe it is practical or even reasonable to consider that private industry should come close to picking up these kinds of things. You have to remember that the kinds of industries that sea grant does its best work for, most of its work for, are small businesses, small companies.

And these are not the kinds of companies that are in a position to make large investments in research and services of this kind.

Senator Pell. And also the demands are going to be much more with the EEZ, the declaration about the economic zone, the 200 mile exclusive economic zone. We will have greater opportunities to exploit, and this is a time when the program should be doubled or tripled or quadrupled.

I remember when we started out we used to think of the idea of turning over certain portions of the ocean to the various universities to be able to develop and grow fish in, and I was reminded—I remember at the time that we continue to fish and we fish today in exactly the same way that my own Indian forebearers used to get their game before you Europeans came over.

We see the Japanese with their county aquacultural agencies and the way they farm the oceans. They do not call their products seaweed; they call it, thinking positively, sea plants.

We have such a long way to go along these lines. What we have done now is just touch it a little bit. I know you share the same thought I do about a vastly expanded use of the oceans for mankind.

Mr. **Knauss**. I think our fishermen are probably doing somewhat better than your ancestors did, Senator; at least they have Loran "C", and the Indians did not. But I agree with you, we have a long way to go and much more to do. The opportunities of the ocean are many, as you well know, and a continuing educated populace of experts in this area are very important.

And Sea Grant plays a very important role.

Senator **Pell**. Well, I thank you very, very much indeed for being with us, Dr. Knauss. And thank you for your testimony. You have been very helpful.

We now have a panel of Dr. E. A. Trabant, president, University of Delaware; Dr. Michael Pelczar, president, Council of Graduate Schools; and, Mr. William McLean, director of the Evinrude School of Marine Technology and Dr. Niels Rorholm is accompanying Dr. Trabant.

I would add here that because of the pressures of time, I would hope all of you could limit the testimony to 5 minutes. We will insert the whole statement in the record. And then we can have time for some questions, too.

And you may start in whichever order you prefer. I would like to add here, as a matter of record, my deep gratitude to Chairman Stafford of the subcommittee. He would be with us conducting the hearing, but he is tied up at another hearing and has permitted me, even though a member of the minority, to conduct this hearing. And I am very grateful to him for it.

And I would add that education has no better friend than Senator Stafford, the Senator from Vermont.

Dr. Trabant, would you lead off.

STATEMENTS OF E. ARTHUR TRABANT, PRESIDENT, UNIVERSITY OF DELAWARE, NEWARK, DEL., ON BEHALF OF THE MARINE DIVISION, NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND GRANT COLLEGES, AND THE SEA GRANT ASSOCIATION, ACCOMPANIED BY NIELS RORHOLM, COORDINATOR, SEA GRANT COLLEGE PROGRAM, UNIVERSITY OF RHODE ISLAND; MICHAEL J. PELCZAR, JR., PRESIDENT, COUNCIL OF GRADUATE SCHOOLS IN THE UNITED STATES, WASHINGTON, D.C.; AND WILLIAM P. McLEAN, ACTING DIRECTOR, EVINRUDE SCHOOL OF MARINE TECHNOLOGY, FLORIDA INSTITUTE OF TECHNOLOGY, STUART, FLA.

Mr. **Trabant**. Thank you, sir. As you have noted, my name is Trabant, Art Trabant; I am the president of the University of Delaware. I am here representing myself as president of the University of Delaware; also as chairman of the Marine Division of the National Association of State University and Land Grant Colleges; and also for the Sea Grant Association.

I have submitted, as you know, a written statement. I am not going to read it.

If I stick to my summary here in the book and do not deviate—but I do know I am going to deviate at least once—I will be through in the 5-minute period.

First, what about the National Association? I think it is important to remind ourselves that the National Association of State Universities and Land Grant Colleges is composed of 140 colleges and universities with a total enrollment of approximately 3.7 million students. We award more than 40 percent of all the collegiate university degrees in the United States, and indeed about 65 percent of all the advanced degrees.

The Sea Grant Association, consists of 35 colleges, universities, research centers, and industry consortia. Many and most members of the Sea Grant Association are members of the National Association of State Universities and Land Grant Colleges.

I would like to express first, Mr. Chairman, my appreciation to you and the other members of your subcommittee for your constant and continued support of higher education and particularly the sea grant program, and to single out you, sir, for your contributions as the leader back in 1966 for the original sponsorship and initiation of the sea grant program.

We applaud that and we have applauded your leadership and contributions through these years.

Now, the sea grant network, as you have heard and know, has complied an extensive documentation on background on reauthorization. And the written testimony is full of that. But I am going to give a brief perspective on why sea grant is unique and why it should be authorized. I am going to give a very brief statement on the importance of the ocean sector in our national economy and then how sea grant contributes to that, and then a few examples of special sea grant accomplishments.

As I go through, you will note I am not going to mention Rhode Island because I came to the conclusion that you knew very well of Rhode Island's accomplishments and that the gentleman to my left would know even more than I about it. But I assure you, sir, that I do know of Rhode Island's accomplishments and it is not because I do not know that they are not in what I am going to say.

Senator PELL. We both represent the two smallest States in the union.

Mr. TRABANT. Indeed we are. I usually refer to ourselves as the State that has three counties at low tide.

The National Sea Grant College program is the only, the only comprehensive research and development partnership in existence. And as you have noted, this partnership links up with Government, industry, business, and our universities. It works in research. It works in education, training, and extension.

Now, we do believe that the sea grant College Program Act should be authorized essentially as it is on a multiyear, long term basis with funding levels significant to do the job. We believe this because we know the sea grant program is working.

You may hear—and I think we did a little bit today—that the need of the sea grant today is not as great as it was in the past; that certainly is just not the case. I will try to show in my brief remarks why it is more critically important today to our Nation than it has ever been before.

So I go then into the ocean sector of the economy. The magnitude of the economic activity within the coastal and ocean sectors has been assessed recently, as the result of sea grant efforts. The analysis of the ocean economic sector in our national income accounting system places in 1972 dollars the ocean sector value at $30.6 billion.

To know whether that is significant or not, compare that with similar figures in the same dollars in agriculture of $35.4 and communications at $29.4 billion. Now, most observers will agree—and there is hardly a voice of dissent—that the commitment of universities and industry to research and extension coupled in with the Federal policy in agriculture was the thing that made agriculture strong in our Nation. And indeed if we did not have our strong agricultural program today, we would not be the Nation that we are.

And it amazes me that if one would use the reason that I have heard today and at other times about the success of sea grant and therefore it should be dismantled, I would also expect to have people with the wisdom to be suggesting that we appropriate $1.7 million to phase out the Department of Agriculture and the cooperation between industry universities and the Federal Government because it has been so successful.

Others take up a red light when they hear the word "grant," sea grant program. And they try to imagine that it is giving money away, that it is a granting process. Do you remember when we started? We took that term, sea grant, to bring it together with the concept of the land grant principle which had proved so successful in our agricultural program.

So I do prefer to refer to it as the sea investment program. Now, in 1981 a sea grant survey provided data on research and extension activities that have had direct economic impact on industry, business, and commerce. And that report outlines the economic impacts of some 57 projects out of a total of more than 800.

The annual gross revenues and savings stimulated by those 57 amounts to $227 million. The 1981 annual figure, then, based upon this small sample of sea grant work is very close to the total amount of money that the Federal Government has invested in the past 13 years in the sea grant program. You heard reference to the MIT study by a group of people not connected with sea grant. Some additional facts on that: those projects that they were looking at, in 1975 there were 77. In 1981, the past year, essentially, they found that 19 of those projects had led to commercial development with annual sales, as you heard, from a minimum of $44 million to a maximum of $62 million.

Perhaps even more important, the original projects have led to 11 new products for industry and business, 10 new companies, having been formed as a direct result of the sea grant efforts, and approximately 25 secondary companies producing the same products.

Therefore, if you use even the most conservative figure of the $40 or $44 million, you can see that that exceeds the maximum funding of the sea grant program by the Federal Government in any 1 year.

Now, in education, training, nearly 7,000 students, mostly at the graduate level, have been educated in the sea grant program since its start. At the University of Delaware let me tell you what it meant to us. It caused the creation—permitted the creation of an interdisciplinary, professional graduate college, the college of marine studies. At our university we have 238 students who have been supported by sea grant money for their degree completion. The top fields of study are marine biology, biochemistry, ocean engineering, marine geology, oceanography; other fields, fisheries, marine policy, marine resource economics. Now, a majority of these students in Delaware—and it is also true nationally—have gone into first employment in marine related professions.

Our data indicate that 40 percent entered the private sector; 32 percent went into public employment; and 28 percent into academic related positions. Now, we do not restrict our work, as you know, to just college personnel. In my report, in the written report, there are many examples. I refer here to the combined efforts of the Atlantic coast sea grant programs to make real time satellite information on the sea-surface temperatures and shifting Gulf Stream flow available to fishermen and shippers.

Has it worked? Well, ask the president of the American Swordfish Association. He has estimated that in 1 year only, the information resulting from this has saved the east coast swordfishermen $2.25 million in 1 year.

Now, in addition to manpower training and education, research, there have been inventions, new technologies, discovery. One at the University of Delaware I call to our attention because of its unusualness. We have developed through our researchers a sea wave power low-cost buoy that through wave energy will produce fresh water.

Two patents have already been granted, and a third application is pending. The economic potential inherent in this novel process has resulted in the formation of a limited partnership called Delbuoy Systems, LP, formed by a group of private investors.

Now, the intent is to commercially manufacture and market Delbuoy's water to local utilities. And the market potential is assessed as being substantial.

Now, looking into the future, in the written testimony, I refer to biotechnology, genetic engineering, robotics, satellite technology, and show how at the present the sea grant program is involved in these areas and will have to get, and will be, more involved in the future.

During the last Congress we heard a great deal about how we needed reindustrialization in our Nation. We had to have more interest in high technology, and that we had to foster greater university, industry, government cooperative activity to revitalize and readjust our economy.

Now, from what I read and understand, the administration has indicated that it shares this year congressional interest in those matters. We would applaud this interest, and I would urge you, sir, to push development in those areas. But at the same time I must say that I remain baffled that there has been this tendency to undervalue and overlook the sea grant program which has been working in this manner for a long time. This, of course, is by the administration. We are one of the most successful models of this kind of activity. I would urge you, sir, and your fellow Senators, to remember this and to recall it to the administration.

My conclusion: I want to share with you a fundamental belief I have. I believe that we derive our greatness as a nation from the strength of our people. The strength of our people, in my opinion, is directly related and directly dependent upon the strength and the worth of our schools and universities.

Furthermore, I do believe that the sea grant program which permits the best possible exploitation of the cooperative efforts of business, industry, Federal Government, our universities and colleges, is one of our most valuable national assets, and it must and should be continued.

Thank you, sir.

[The prepared statement of Mr. Trabant follows:]

STATEMENT OF
PRESIDENT E. ARTHUR TRABANT
UNIVERSITY OF DELAWARE
ON REAUTHORIZATION OF
THE NATIONAL SEA GRANT COLLEGE PROGRAM ACT (S.655)

BEFORE THE

SUBCOMMITTEE ON EDUCATION, ARTS, AND HUMANITIES

COMMITTEE ON LABOR AND HUMAN RESOURCES

ON BEHALF OF THE NATIONAL ASSOCIATION OF

STATE UNIVERSITIES AND LAND GRANT COLLEGES

AND THE

SEA GRANT ASSOCIATION

April 7, 1983

Thank you, Mr. Chairman, and good morning. My name is E. Arthur Trabant. I am President of the University of Delaware. I am appearing today on behalf of myself, the Marine Division of the National Association of State Universities and Land Grant Colleges, and the Sea Grant Association. We appreciate the opportunity to testify before the Subcommittee on Education, Arts, and Humanities. I have submitted a written statement for the record and will summarize its main points this morning.

The National Association of State Universities and Land Grant Colleges (NASULGC) is composed of 140 colleges and universities with a total enrollment of approximately 3.7 million students. These institutions award more than 38% of all U.S. higher education degrees, including 64% of all doctorate degrees. Many of the foremost contributors to research and education on the oceans and their resources are located on these campuses. The Sea Grant Association consists of 35 colleges, universities, research centers, industries, and consortia, all dedicated to enhancing the nation's capability to develop, use, and manage our marine resources. Most members of the Sea Grant Association are also members of NASULGC. Over the past five years, the Sea Grant programs have supported education, research, and public service activities at over 250 educational institutions in 39 states, plus Guam, Puerto Rico, and the District of Columbia.

I would like to express our appreciation, Mr. Chairman, to you and the other members of this committee for your long-time support of higher education and the National Sea Grant College Program. I particularly want to recognize Senator Pell's imagination and foresight in introducing the original Sea Grant legislation and on behalf of the Sea Grant community wish to thank him for his leadership and continuing support. As a

Delawarean, I also point with pride to the bipartisan support of our two senators for the Sea Grant reauthorization legislation.

The Sea Grant network has compiled extensive documentation as background for reauthorization. My testimony today will summarize the essence of these materials, and the attachments to the testimony will amplify my presentation. I wish to concentrate on the following points:

- A perspective on why Sea Grant is unique, important, and should be reauthorized.
- A review of the ocean sector of the economy and Sea Grant's contribution to that sector.
- Some examples of Sea Grant contributions.
- An outline of basic documentation which we have provided to the Congress, demonstrating our continuing emphasis on results and our willingness to be judged on the basis of performance.

SEA GRANT--A NATIONAL ASSET

The National Sea Grant College Program is the only comprehensive research and development partnership linking the federal government, industry, and universities that is designed to foster the development of our nation's marine resources through research, manpower education and training, and extension. Mr. Chairman, the Sea Grant community strongly believes that the National Sea Grant College Program Act should be reauthorized essentially as it is, on a multi-year, long-term basis, and with funding levels sufficient to do the job. We base this request on our past record. The Sea Grant Program works. It has done precisely what the Congress established it to do. We have achieved our results by becoming a model for university-industry-government partnership in the field of marine resources, and by concentrating on our role as an investment in the marine sector of the economy. We are a merit-based, tightly managed, and highly competitive national network of locally based programs, attacking problems at the grassroots level long before they are perceived in Washington, D.C. In slightly more than a decade, Sea Grant has effectively marshalled the capabilities of universities to address the needs and problems of our nation's industries and citizens. The Sea Grant Program fills a unique role in marine resource development, and in doing so has become a significant national asset.

The need for Sea Grant today is as great as ever and only continues to intensify. Issues such as extended jurisdiction, outer continental shelf resource development, and Great Lakes transboundary questions, as well as the scientific potential unleashed by breakthroughs in such areas as biotechnology and high technology, continue to create new needs and new opportunities for Sea Grant--for our research, for our advisory services, and especially for our students.

The Sea Grant Programs undertake many different efforts for a variety of reasons. The oceans and coasts are diverse, and the needs of the marine environment and the people who use it require diverse approaches. Not all of this work can be or should be quantified, and not all of it can be measured in economic terms. However, in order to understand how and why Sea Grant works and why it is more critically important to the nation than ever, we need to understand the ocean sector of the economy and Sea Grant's contribution to that sector.

SEA GRANT AND THE NATIONAL ECONOMY

The economic development potential of the marine and coastal resources of the United States has attracted much attention in recent years. However, the magnitude of this economic activity within the coastal and ocean sectors only recently has been assessed, largely as a result of Sea Grant efforts (Science, Vol. 208, 30 May 1980). This analysis of the ocean economic sector in the National Income Accounting System (NIAS) places the ocean sector value at $30.6 billion in 1972 dollars, which is comparable to agriculture ($35.4 billion), mining ($18.9 billion), construction ($58 billion), transportation ($46.2 billion), and communications ($29.4 billion). This NIAS assessment is based upon nine major industrial subsectors:

1. Commercial fishing (harvesting, processing, and aquaculture).
2. Marine mining (oil and gas, sand and gravel, and limestone).
3. Marine construction.
4. Manufacturing (ship and boat building).
5. Marine transportation and communication (shipping, cargo handling and warehousing, transportation services, and marine-related communications).
6. Marine-related retail trade (marine-related merchandising and and retailing).
7. Marine financing, insurance, and real estate.

8. Marine services (hotels, marine recreation, educational services, museums, and marine organizations).

9. Public administration--state and local (federal government, ocean-related activities).

It is important to understand the structure and characteristics of the industrial, business, and commerce components of the ocean sector. With the exception of the oil and gas industry, most of the industries within the private marine sector are discrete, often small evolving units. The commercial fishing industry, for example, is comprised mainly of small independent businesses and is characteristic of these units. The National Sea Grant Program's marine resources development work is focused on the ocean economic sector and its many diverse, fragmented activities.

Most observers agree that the commitment of universities and industry to research and extension was the key to federal policy that so effectively encouraged the agricultural industry. In 1966, the federal government established a similar policy and structure for encouraging development of the ocean sector through the National Sea Grant College Program legislation. Its intent is "to accelerate national development of marine resources, including their conservation, proper management, and maximum social and economic utilization." More specifically, the program was directed to "achieve the gainful use of marine resources" through a partnership between the federal and state governments, universities, and the private sector. The term "Sea Grant" was chosen to emphasize the agricultural parallel in meeting contemporary national needs by developing the economic potential of our marine resources.

A 1981 National Sea Grant survey provided data on research and extension activities that have had direct economic impacts on industry, business, and commerce. This analysis, with which you may already be familiar, is summarized in a report entitled "Economic Effects of Sea Grant." The report outlines the economic impacts of 57 (out of about 800 in total) Sea Grant projects and documents their effects on industry, business, and commerce, using the major marine categories of the National Income Accounting System. The annual gross revenues and savings stimulated by those 57 efforts amounts to $227 million. The 1981 annual figure, based on this small sample of Sea Grant work, is very close to the total 13-year amount the federal government had invested in Sea Grant between 1968 and 1981.

Another recent study, again looking at a very small sample of Sea Grant work and at only one kind of economic indicator, sales, graphically demonstrates Sea Grant's achievements:

> In 1976, a MIT research team not associated with Sea Grant, reviewed 77 projects funded in one year (1975) to determine if they might lead to new commercial products. These projects were reassessed again this past year. In 1981, 19 of these projects have led to commercial development with annual SALES of $44-62 million. Further, the original projects have led to 11 new products for industry and business, with 10 new companies having been formed as a direct result of Sea Grant efforts, with approximately 25 secondary companies producing the same products.

Thus, using the most conservative figure of $44 million in annual sales from this small sample of projects, this annual figure exceeds the highest annual appropriation Congress ever made to Sea Grant. When you think of all the other projects with economic implications and of all the other kinds of economic benefits besides sales (such as cost savings or jobs preserved), you can understand one reason why we keep speaking of Sea Grant as an investment.

SEA GRANT CONTRIBUTIONS

The needs for well-trained professionals, for technological advance, and for better application of technology are matters of concern to this committee, the Congress, the administration, and the country. By way of a few examples, I would like to indicate Sea Grant's contributions.

A University's primary product is an educated and well-trained graduate. Sea Grant has contributed to the education and training of nearly 7,000 students, mostly at the graduate level, since 1968. At the University of Delaware, the creation of an interdisciplinary, professional graduate college was stimulated by the Sea Grant College Program. Also, at our University, 238 students have received some form of Sea Grant support contributing to their degree completion. The top fields of study are marine biology and biochemistry, ocean engineering, marine geology, and oceanography. Other significant fields include fisheries, marine policy and marine resource economics. A majority of these students, in Delaware and nationally, have gone to first-employment in marine-related professions. Our data indicate that 40 percent entered the private sector, 32 percent public employment, and 28 percent academic-related positions.

In 1979, Sea Grant established a program to augment a student's campus-based educational experience with a work/internship opportunity. Specifically, student interns are offered the opportunity to address real world marine issues through a variety of jobs within the Congress, Federal Agencies and Commissions. Of the 54 interns named since 1979, 31 have completed their degrees and are currently employed in various agencies and companies. The remaining 23 are presently in the process of completing degree requirements. We are pleased to have been able to add this valuable opportunity to the formal educational experiences.

Sea Grant universities do not restrict the educational process to their matriculated students. On the contrary, a significant educational effort is mounted through the advisory services. For example, I want to mention the pioneering efforts of Rhode Island and Georgia Sea Grant programs, among others, to bring modern technology to the fishing industry. These efforts are helping a badly distressed sector of the marine economy. A major undertaking of our newest regional Sea Grant network, the Southeast Marine Advisory Service, is aimed at spreading this new technology more widely. Perhaps even more dramatic has been the combined efforts of the Atlantic coast Sea Grant programs to make real-time satellite information on sea surface temperatures and shifting Gulf Stream flow available to fishermen and shippers. The President of the American Swordfish Association has estimated that in one year only this information saved the east coast swordfishermen $2.25 million and resulted in greater catches.

In addition to manpower training and education, universities are also engaged in the conduct of research leading to scientific discoveries, inventions, and new technologies. The Sea Grant network, through its research, is addressing a wide variety of marine resource development opportunities; for example:

- o At the University of Delaware, sea-wave-powered research has developed a low-cost buoy that uses wave energy to produce fresh water. Two patents have already been granted and a third application is pending. The economic potential inherent in this novel process has already resulted in the formation of a limited partnership, DELBUOY Systems LP, by a group of private investors. The intent is to commercially manufacture and market DELBUOYs and/or to market water to local utilities. The market potential has been assessed as being substantial.

- o Washington Sea Grant's pioneering work in underwater acoustics has not only created a new technology that is transforming fishery management, but it has created a new domestic industry: the manufacture of high precision acoustic instrumentation. Biosonics, Inc. formed in 1978, today employs more than 60 people and annually manufactures and sells several million dollars worth of equipment to customers throughout the United States--and eight foreign countries.

- o The California Sea Grant Program has developed a squid processing machine which is patented and now being engineered for commerical production by a California company. It is estimated that the machine will permit a fifty-fold increase in the squid catch off the coast of California.

- Floating-tire breakwaters, using discarded automobile tires, were developed by Sea Grant research personnel. They are now being installed throughout the U.S. and in other nations. It is a proven low-cost technique for wave control in harbors and marinas.

- Sea Grant sponsored research and education in cold water drowning and revival techniques have saved hundreds of lives worldwide.

Mr. Chairman, there are a number of areas of scientific breakthrough that offer great promise to our nation's ocean effort. Biotechnology and genetic engineering will help us find stronger, disease-resistant fish strains both for aquacultural rearing and for restocking the oceans. The applications of satellite technology are just beginning. Computers are now essential in aiding structural design and in making both government and industrial management more effective. Robotics and offshore and underwater work systems are central to our growing use of the ocean. It is important to emphasize that Sea Grant is already very heavily involved in these areas.

During the last Congress and again this year, there has been a great deal of interest in reindustrialization, in high technology, in technical and scientific manpower training and in fostering university/industry and university/government cooperative activity to revitalize our economy. This year, the administration has indicated that it shares the congressional interest in these matters. We applaud this interest and urge you to push developments in these areas. At the same time, we are somewhat baffled that there has been a tendency to overlook Sea Grant, which has been working on these matters in the marine sector for a long time now. We are one of the models for successful activity, and we would urge you and the administration to remember this.

SEA GRANT DOCUMENTATION

Mr. Chairman, the Sea Grant community has recently prepared a Resource Book for use by program personnel at our various universities as a means of information exchange and program development. It also serves as a basic background document for Congress with regard to Sea Grant reauthorization. We believe this to be the most extensive documentation ever prepared on a program of this size in the area of this committee's jurisdiction. We have provided copies to many members of your staffs and will furnish others as needed. My testimony today is largely a summary of parts of the Resource Book. Since the book itself is too long and bulky for submission with this testimony, we have provided the following excerpts as attachments:

- A statement on "Reauthorization of the National Sea Grant College Program".
- The "Contents and Summary" of the Resource Book, which outlines what kinds of information in available.
- A summary of "Some Recent Sea Grant Accomplishments".
- Two one-page documents from my University of Delaware Sea Grant College Program, as examples of materials contributed by members of the network.

In conclusion, I want to share with you some beliefs I have about my state which I feel are true for the nation. Delaware derives its greatness from the strength of its people, the wealth of its natural resources, and from the excellence of its schools and universities. Wherever I travel in Delaware, I find the university at work bettering the lives of our citizens--on the farm, in our industries, along the waterfront. In our state, we practice the business of research, extension and education with our sleeves rolled up, our minds open and our facts straight. This approach has already paid off for several generations of Delaware farmers. A dozen years ago, Sea Grant began putting the same formula to work for fishermen, for coastal communities, and for all the rest of us who have a vested interest in marine resources.

Those that I represent, as well as I, feel that the record justifies continuation and enhancement of the National Sea Grant College Program. We have provided extensive information documenting the results of the program. We believe that the results speak for themselves, and that by any standard the program is a valuable national asset. Finally, we believe that the many groups and people who have used Sea Grant's work--industry, business, the public sector, citizen's groups and individuals--will continue to join us in demonstrating that the Sea Grant idea works, and that it is vital to the future of our national ocean policy.

Thank you.

Senator **Pell**. Thank you very much. Dr. Rorholm? I think we will go right down the panel and then ask questions after that.

Mr. **Rorholm**. Senator Pell, I do not have a prepared statement, but——

Senator **Pell**. I find this document of COIT/benefit for the State of Rhode Island sea grant program a very interesting document.

Mr. **Rorholm**. I would be glad to summarize the document that I am prepared to leave with you.

Senator **Pell**. Excuse me for interrupting, but this is just the kind of document for which I have been asking because it shows the cost benefits of the sea grant program. I just wish that all the recipients, the people engaged in the program, had made out a similar document because when I add up what it has meant to Rhode Island, it comes to $9,742,000, not counting lives saved or items that you do not know the answer to.

If that was done for all the universities that received $1 million grants from it, it would be a very good argument to make.

Mr. **Rorholm**. Thank you. I think most of the programs have tried—I am sure you also realize, Senator Pell, that it is very difficult to put dollar values on everything, and we should be very careful not to overdo that.

However, the dollar values, the economic benefits which are either in the form of increases in gross revenues or in cost reductions from sea grant have been considerable. And I would like to make the point that they would not occur if this program were turned over to industry.

If industry did this type of work, industry would keep the results to itself, and would capitalize on it in their monopoly positions of having this knowledge. Cooperative with sea grant, the excellent matching funds we receive from industry and from our State universities has made it possible to generate the information, and whereas, of course, the cooperating industries know the information first, it nevertheless is spread to other businesses and industries and to people at large.

This is one of the real advantages of sea grant. Now, very quickly on the economic effects, they are, for Rhode Island, about 8½ times the average annual grant that the university has received for sea grant.

Many of those projects are of regional and national nature. If I count down the examples, the 17 or 16 monetary examples I have here, then I find that one—and that is a very small one, No. 5, $3,000 of benefit—is probably the only one I can say that is strictly local. It was a matter of helping a local industry.

Now, it is quite likely that the technique they learned will spread. Four of the sixteen I have are regional. And 11 of these 16 projects are national in scope in the sense that the information is spreading nationally and is being used by other sea grant programs even as we use information developed by those programs.

I think that is a very important part of the program. I would like briefly to mention with respect to education the very important feature that you, as one of the founders of the sea grant program and your colleagues at the time built into the program; namely, to keep manpower training an important part of it.

That is not only to improve our future ability to use the oceans and coasts productively, but also to gain in our research projects from the inquisitive minds of the young people that are working along with the faculty members.

At the University of Rhode Island, sea grant college program, 460 students have contributed to the research, and therefore, received financial assistance. In addition, 600 students have graduated from four different educational programs, ranging from the University of Rhode Island Fisheries School to the marine affairs program to the master's and Ph. D. programs in marine resource economics.

Sea grant is no longer putting money into those programs. They are being handled and financed by the university itself. I am glad to say, however, that apparently the need for manpower is not completely exhausted because graduates go out and get jobs, and the university has not cutback any of these programs. And I can assure you, Senator Pell, that the university cuts back on programs that are unnecessary these days.

Senator PELL. Thank you very much indeed, Dr. Rorholm. Dr. Pelczar.

Mr. PELCZAR. Mr. Chairman, my name is Michael Pelczar. I am the president of the Council of Graduate Schools in the United States which is made up of 365 of the major institutions that are involved in graduate education. But I also have a connection with sea grant by virtue of having been involved at the University of Maryland in initiating the sea grant program at the university several years ago. I am also chairman of the National Sea Grant Advisory Panel.

I want to express my appreciation to you for the opportunity to talk about the sea grant program and to convey to you my strong support, as well as and that of my colleagues, for this most important program. I have prepared a statement, in itself relatively brief in terms of articulating all of the important features of the sea grant program, I have narrowed my oral presentation down to emphasize two points.

Now, President Trabant has touched upon them, but I would like to proceed to emphasize what I regard as two extremely important features of the sea grant program above and beyond the acquisition of knowledge. One of these is the promotion of partnership activities by sea grant, partnerships between universities, industry, and business and governments, both State and Federal. The second point that I want to underscore is the promotion of interdisciplinary research during the education and training of students.

There is a great amount of interest and discussion presently, as you are aware, Senator, about the importance of university, industry, and government partnerships. There have been three major national conferences within the last several months on this topic. The 14th annual report of the National Science Board is entitled "Industry-University Partnerships: Myths, Realities, and Potential."

Dr. George Keyworth, the President's science adviser, just last week at the American Association for the Advancement of Sciences' R&D colloquium on the fiscal 1984 budget commented as follows:

> Most academic and federal scientists still operate in virtual isolation from the expertise of industry and from the experience and guidance of the marketplace.
>
> One can make a convincing case that this separation is a root cause of our sluggishness compared to some of our more energetic competitors in turning research into products.

Mr. Senator, as you are aware, the structure of the sea grant program is such that it is a strong promoter and practitioner of this concept of partnerships. Each State sea grant program, for example, has an advisory committee to the director. I serve on the advisory committee for the Maryland sea grant program. And we have people from State government, people from the National Marine Fisheries Laboratory, people from commercial fisheries, seafood processors, and many others that participate in the deliberations of the program. We advise the director on the direction of the program.

Similarly, the National Advisory Panel which I serve on, has university, State government, and industrial representation. The director of research for Raytheon Corp., for example, Dr. John Blair, is a member of that committee. The director of the Southern California Coastal Water Research Project is a member of that committee. A member of the North Carolina Utilities Commission is on that group. What I am trying to emphasize, Mr. Chairman, is that the Sea Grant program has in place a model of this kind of a partnership, and many of its activities are pursued with such partnerships.

The intent, of course, is to promote synergistic output from the combined talents and resources of these constituencies.

My second point concerns the education and training of students in sea grant. Dr. Trabant has already commented upon the numerous disciplines from which students come to participate in the program. The diversity of student participation underscores the interdisciplinary emphasis associated with sea grant education, training, and research. Students in the sea grant program view research in its full spectrum, from the significance of fundamental observations to the implementation of fundamental discoveries into some practical process or product for society.

We are becoming increasingly aware of the importance of developing this interdisciplinary, interactive mode. The complex issues that confront society are not solvable by a single, specialized discipline. They require the input of many disciplines, from the natural sciences to the humanities, the social sciences and others. Bringing together these talents and expertise gives us the best hope for developing the kind of wisdom that will result in a judgment or a conclusion that may result in an incremental improvement of a particular issue.

I will conclude, Mr. Senator, by simply saying that here we have two very prominent features of the sea grant program that on the national scene could readily serve as models for other programs. Hence, we are extremely enthusiastic about these and other aspects of the program. And we are very desirous of providing the kind of support that might be of assistance in building a former base for the program.

[The prepared statement of Dr. Pelczar follows:]

STATEMENT BY
DR. MICHAEL J. PELCZAR, JR.
ON REAUTHORIZATION OF
THE NATIONAL SEA GRANT COLLEGE PROGRAM ACT

S. 655

BEFORE THE

SUBCOMMITTEE ON EDUCATION, ARTS, AND THE HUMANITIES

COMMITTEE ON LABOR AND HUMAN RESOURCES

U.S. SENATE

ON BEHALF OF THE

COUNCIL OF GRADUATE SCHOOLS IN THE UNITED STATES

APRIL 7, 1983

MR. CHAIRMAN, MEMBERS OF THE SUBCOMMITTEE, MY NAME IS MICHAEL J. PELCZAR, JR. I AM PRESIDENT OF THE COUNCIL OF GRADUATE SCHOOLS IN THE UNITED STATES AND AM TESTIFYING ON BEHALF OF THAT ORGANIZATION TODAY. I ALSO HAVE A LONG RELATIONSHIP WITH THE SEA GRANT PROGRAM, FIRST AS THE ORIGINAL DIRECTOR OF THE MARYLAND SEA GRANT PROGRAM AND CURRENTLY AS THE CHAIRPERSON OF THE SEA GRANT NATIONAL REVIEW PANEL. I APPRECIATE THIS OPPORTUNITY TO TESTIFY IN SUPPORT OF S. 655 TO REAUTHORIZE THE NATIONAL SEA GRANT COLLEGE PROGRAM. MY COMMENTS TODAY WILL SUMMARIZE THE WRITTEN STATEMENT I HAVE SUBMITTED

MR. CHAIRMAN, AS YOU KNOW, THE SEA GRANT NETWORK HAS COMPILED CONSIDERABLE INFORMATION WHICH DOCUMENTS THE SCOPE AND DIVERSITY OF SEA GRANT'S ACCOMPLISHMENTS AND THE IMPACT OF THESE ACCOMPLISHMENTS ON THE NATION'S ECONOMY. SPECIFICALLY, I REFER YOU TO TWO REPORTS--"THE ECONOMIC EFFECTS OF SEA GRANT," PREPARED BY THE SEA GRANT TASK FORCE IN 1982, AND "THE NATIONAL SEA GRANT COLLEGE PROGRAM:1983," A RESOURCE DOCUMENT PREPARED FOR THE CURRENT REAUTHORIZATION DELIBERATIONS. I MENTION THESE REPORTS TO EMPHASIZE THE AVAILABILITY OF BACKGROUND INFORMATION ABOUT SEA GRANT THAT IS MUCH MORE DETAILED AND COMPREHENSIVE THAN THE BRIEF REPORT I WILL MAKE TODAY. I BELIEVE THAT YOU WILL CONCUR THAT FROM THE INFORMATION PROVIDED IN THESE REPORTS ONE CAN DEVELOP STRONG SUPPORT FOR THE REAUTHORIZATION OF THE NATIONAL SEA GRANT COLLEGE PROGRAM. MY COMMENTS TODAY EMPHASIZE THE SIGNIFICANT CONTRIBUTION OF SEA GRANT TO STRENGTHENING THE OCEAN AND MARINE SECTORS OF THE ECONOMY THROUGH ITS ACTIVITIES IN

GRADUATE EDUCATION.

I HAVE BEEN ASSOCIATED WITH GRADUATE EDUCATION FOR PRACTICALLY ALL OF MY ADULT LIFE. I SERVED AS VICE PRESIDENT FOR GRADUATE STUDIES AND RESEARCH FOR THE UNIVERSITY OF MARYLAND FOR 12 YEARS, AND I HAVE BEEN SERVING SINCE SEPTEMBER 1978 AS PRESIDENT OF THE COUNCIL OF GRADUATE SCHOOLS IN THE UNITED STATES. MORE THAN EVER BEFORE, I AM CONVINCED THAT EDUCATION AND TRAINING--AND GRADUATE EDUCATION AND TRAINING IN PARTICULAR--IS ESSENTIAL TO BOTH THE QUALITY OF LIFE, THE ECONOMIC GROWTH OF THE NATION.

MY CONVICTION IS BASED ON TWO PREMISES:

1. THIS NATION NEEDS TO CONSTANTLY ADD TO ITS STOCKPILE OF KNOWLEDGE--TO CONTINUALLY STRIVE TO INCREASE OUR KNOWLEDGE BASE--AND SECONDLY,

2. MORE PEOPLE NEED TO EXPAND AND IMPROVE THEIR UNDERSTANDING OF THIS KNOWLEDGE--TO ACQUIRE A BROADER COMPREHENSION OF OUR NEW KNOWLEDGE.

ADDING TO THE STOCKPILE OF KNOWLEDGE AND INCREASING THE NUMBER OF PEOPLE WITH BETTER UNDERSTANDING OF THIS KNOWLEDGE ARE, IN MY VIEW, THE CENTRAL OBJECTIVES OF GRADUATE EDUCATION. OBVIOUSLY, I AM NOT ALONE IN MY BELIEFS. THE NEED FOR TECHNOLOGICAL ADVANCES, FOR BETTER APPLICATIONS OF TECHNOLOGY AND FOR MORE INVESTMENT IN SCIENTIFIC AND ENGINEERING MANPOWER IS OF GREAT CONCERN TO THIS COMMITTEE,AND TO CONGRESS. JUDGING BY THE PRESIDENT'S RECENT STATE OF THE UNION ADDRESS AND BY THE FY84

BUDGET, IT IS A GREAT CONCERN OF THIS ADMININSTRATION.

THE "NEW" RECOGNITION OF THE IMPORTANCE OF EDUCATION AND TRAINING AT ALL LEVELS AND PARTICULARLY EDUCATION AND RESEARCH AT THE GRADUATE LEVEL, STEMS IN PART FROM THE "RUSH" INTO HIGH-TECHNOLOGY AND THE CONCOMMITANT NEED FOR MORE AND BETTER SCIENCE AND ENGINEERING RESEARCH AND DEVELOPMENT. MARGARET BURBIDGE PRESIDENT OF AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (A.A.A.S.) AND DIRECTOR, CENTER FOR ASTROPHYSICS AND SPACE SCIENCES UC-SAN DIEGO COMMENTED UPON THIS CHANGE IN MOOD AS SHE INTRODUCED THE 8TH ANNUAL AAAS COLLOQUIUM ON R&D POLICY IN WASHINGTON, D.C. THURSDAY (MARCH 24-25, 1983). THE TITLE OF THE COLLOQUIUM WAS: "R&D, HIGH TECHNOLOGY, AND ECONOMIC RECOVERY". BURBIDGE SAID THAT THE PRESENT ENVIRONMENT IS SOMETHING LIKE THAT OF THE SPUTNIK ERA, E.G.:

-THERE IS GROWING CONCERN ABOUT THE INTERNATIONAL STANDING OF U.S. SCIENCE AND TECHNOLOGY

-THAT OUR INTERNATIONAL REPUTATION IN SCIENCE AND TECHNOLOGY IS SLIPPING

-THIS IS VERY WORRISOME AS THE NATION SEEKS TO IMPROVE ITS ECONOMIC POSITION VIA DEVELOPMENTS IN HIGH TECHNOLOGY.

WE ARE CURRENTLY BEING FLOODED WITH NEWS ABOUT NEW HIGH TECHNOLOGIES AND THE NEED FOR THE U.S. TO GAIN A LEAD POSITION. SUCCESS IN THE HIGH TECHNOLOGY INDUSTRIES IS REGARDED BY MANY AS THE SAVIOR FOR OUR ECONOMIC DIFFICULTIES. OBVIOUSLY, THIS ENTHUSIASM FOR HIGH TECHNOLOGY NEEDS TO BE TEMPERED WITH SOME

DEGREE OF REALISM.

LAST WEEK'S ISSUE OF BUSINESS WEEK (MARCH 29, 1983) DISCUSSED THE HIGH TECHNOLOGY ISSUE IN ARTICLES BY THESE TITLES WHICH REFLECT SOME OF THE ISSUES:

"AMERICA RUSHES TO HI-TECH FOR GROWTH"

"POLITICIANS CLIMB ON THE HI-TECH BANDWAGON"

"LOW-TECH EDUCATION THREATENS THE HIGH-TECH FUTURE"

THE FACT IS THAT WE HAVE LOST OUR LEAD IN TRADITIONAL INDUSTRIES SUCH AS TEXTILES, RADIO AND T.V. AND MANY SMOKE-STACK INDUSTRIES. WE CANNOT AFFORD TO LOSE OUT IN THE NEW HIGH-TECH FIELDS. THE PREDICAMENT WE FACE IS HIGH-LIGHTED IN THE RECENT BOOK "GLOBAL STAKES," BY JAMES BOTKIN, DAN DIMANESCU, AND RAY STATA. THE JACKET OF THIS BOOK READS AS FOLLOWS:

"CHALLENGED BY GLOBAL COMPETITORS; STALLED BY HUMAN RESOURCE SHORTAGES; SIDE-TRACKED BY RISING DEFENSE EXPENDITURES; AND HIT BY CUTBACKS IN EDUCATION--AMERICAN HIGH TECHNOLOGY AND HIGHER EDUCATION ARE PLUNGED INTO A GAME OF GLOBAL STAKES!"

THE AUTHORS STATE THAT THE GROWTH AND VITALITY OF THESE NEW, DYNAMIC INDUSTRIES ARE THREATENED BY A SHORTAGE OF BRAIN POWER IN THE UNITED STATES. AMERICA'S LEADERSHIP HAS FAILED TO RECOGNIZE THE SHIFT FROM A CAPITAL-INTENSIVE ECONOMY TO A KNOWLEDGE-INTENSIVE ECONOMY. THEY ARGUE FOR A VIGOROUS REVITALIZATION OF AMERICA'S EDUCATIONAL SYSTEM.

SEA GRANT HAS CONTRIBUTED AND IS CONTRIBUTING TO THE

DISCOVERY OF NEW KNOWLEDGE AND NEW TECHNOLOGIES OF NATIONAL NEED WITH RESPECT TO MARINE AND OCEAN AFFAIRS. GRADUATE AND UNDERGRADUATE STUDENTS, BY PARTICIPATING IN SEA GRANT RESEARCH AND EDUCATION, ARE GAINING INVALUABLE LESSONS IN NEW AND DEVELOPING FIELDS, IN FIELDS SUCH AS UNDERWATER ACOUSTICS, UNDERWATER WORK SYSTEMS, ROBOTICS AND MARINE BIOTECHNOLOGY. THE LEARNING IS NOT SOLELY FOR THE SAKE OF LEARNING. THE KNOWLEDGE A STUDENT GAINS ALSO PREPARES HIM FOR JOB OPPORTUNITES IN NEW GROWTH, HIGH TECHNOLOGY INDUSTRIES. FOR EXAMPLE, THE UNIVERSITY OF WASHINGTON'S PIONEERING SEA GRANT WORK IN UNDERWATER ACOUSTICS HAS HAD A NUMBER OF BENEFITS, INCLUDING:

-IMPROVED PRECISION IN ACOUSTIC SURVEYS WHICH HAS MADE IT POSSIBLE TO INCREASE SUBSTANTIALLY THE YIELDS OF SEVERAL FISHERIES WHILE PERMITTING ADEQUATE ESCAPEMENT FOR SPAWNING.

-THE BIRTH OF A NEW DOMESTIC INDUSTRY-THE MANUFACTURE OF HIGH PRECISION ACOUSTIC INSTRUMENTATION NEEDED FOR RESEARCH AND FISHERY MANAGEMENT AGENCIES. BIOSONICS, INC., FORMED IN 1978 BY FORMER SEA GRANT RESEARCHERS, TODAY EMPLOYS MORE THAN 60 PEOPLE AND ANNUALLY MANUFACTURES AND SELLS SEVERAL MILLION DOLLARS WORTH OF EQUIPMENT TO CUSTOMERS THROUGHOUT THE UNITED STATES AND EIGHT FOREIGN COUNTRIES.

-A NEW TECHNOLOGY FOR STUDYING FISH BEHAVIOR AROUND WATER INTAKES OF SUCH DIVERSE STRUCTURES AS NEAR-SHORE THERMAL POWER PLANTS, HYDROELECTRIC TURBINES, AND PUMPS THAT FORCE SEA WATER INTO OFFSHORE OIL FIELDS TO INCREASE OIL RECOVERY. THESE STUDIES ARE GUIDING DESIGN ENGINEERS AND PLANT OPERATORS IN THE

MODIFICATION OF STRUCTURES AND OPERATING PROCEDURES TO MINIMIZE THE INGESTION OF FISH.

-IMPROVED DESIGN AND USE OF FISH NETS FOR BOTH SAMPLING AND HARVESTING. IN ORDER TO COMPARE THE EFFICIENCY OF ALTERNATIVE NET DESIGNS OR PROCEDURES, IT IS NECESSARY TO KNOW THE POPULATION DENSITY AND BEHAVIOR OF FISH IN A TEST AREA. THESE FACTORS CAN VARY WIDELY OVER BRIEF TIME INTERVALS FOR MANY REASONS, BUT AN ACOUSTIC SURVEY CONDUCTED SIMULTANEOUSLY WITH EACH TEST CYCLE PERMITS ACCURATE ASSESSMENT OF FISH DENSITY AND BEHAVIOR.

-DEVELOPMENT OF HYDROACOUSTIC TOOLS AND METHODS USED BY THE NATIONAL MARINE FISHERIES SERVICE AND THE FISHERIES MANANGEMENT AGENCIES OF WASHINGTON, ALASKA, AND BRITISH COLUMBIA TO

-ROUTINELY ASSESS HERRING AND POLLOCK STOCKS

-MONITOR JUVENILE SALMON IN REGIONAL LAKES

-MEASURE POTENTIAL YIELD OF NEW FISHERIES SUCH AS HAKE.

THE ACCOMPLISHMENTS OF THE UNIVERSITY OF SOUTHERN CALIFORNIA ARE OTHER EXAMPLES OF SEA GRANT'S CONTRIBUTION TO TRAINING OUR FUTURE MARINE LEADERS. SPECIFIC EXAMPLES INCLUDE:

-DEVELOPMENT OF A NEW AND INEXPENSIVE ASSAY FOR THE TOXINS THAT CAUSE PARALYTIC SHELLFISH POISONING.

-POLLUTION STUDIES IN THE LOS ANGELES AND LONG BEACH HARBORS.

-SERIES OF GRADUATE COURSES ON SEAPORT MANAGEMENT.

-TEACHER GUIDES ON INCORPORATING MARINE SUBJECTS INTO SCHOOL CURRICULA.

-STUDIES OF NEARSHORE FISHERIES.

-MODELS OF WAVE BEHAVIOR IN HARBORS AND AROUND STRUCTURES.

-INVENTORY OF OFFSHORE SAND AND GRAVEL RESOURCES.

THE DEMAND FOR TRAINED GRADUATES IN FIELDS SUCH AS OCEAN ENGINEERING IS GROWING, AND SEA GRANT IS ONE OF THE FEW WAYS IN WHICH THIS COUNTRY IS TRYING TO MEET THIS DEMAND. ON ONE RESEARCH TEAM PUT TOGETHER TO WORK WITH A MAJOR OIL COMPANY IN DEVELOPING THE TECHNOLOGY NEEDED TO OPERATE IN THE OFFSHORE REGIONS OF THE ALASKAN ARCTIC, THREE OF THE NINE PH.D. ENGINEERS HAD RECEIVED MAJOR FINANCIAL ASSISTANCE FOR THEIR DOCTORAL PROGRAM FROM SEA GRANT. IN THE FIRM OF BRIAN WATT ASSOCIATES, INC., A LEADING ENGINEERING CONSULTING FIRM IN DEVELOPING ARCTIC OFFSHORE TECHNOLOGY, 4 OF THE 15 GRADUATE ENGINEERS WERE INVOLVED IN SEA GRANT RESEARCH AS STUDENTS.

TO EXPLORE AND DEVELOP OUR OCEAN RESOURCES, WE WILL NEED NEW KINDS OF ENGINEERS AND NEW KINDS OF RESEARCH. WE WILL ALSO NEED PEOPLE EDUCATED AND TRAINED WITH NEW APPROACHES FOR RESOLVING COMPLEX LEGAL, SOCIAL, ECONOMIC AND ENVIRONMENTAL ISSUES. THROUGH SEA GRANT, YOUNG MEN AND WOMEN BECOME INVOLVED IN PROBLEM-ORIENTED RESEARCH, RESEARCH THAT CONNECTS CLASSROOM KNOWLEDGE AND LABORATORY SKILLS WITH THE HARD REALITIES OF SOCIAL, ECONOMIC, AND ENVIRONMENTAL SITUATIONS. THE RESEARCH ENCOURAGES STUDENTS TO WORK ON THE KIND OF INTERDISCIPLINARY TEAMS THAT ARE NOT ALWAYS FOUND IN A UNIVERSITY DEPARTMENT. HOWEVER, THESE PROBLEMS PROVIDE EXPERIENCE WHICH IS ESSENTIAL TO

TACKLING THE REAL-WORLD PROBLEMS AND OPPORTUNITIES OF TODAY AND TOMORROW. DR. EDWARD DAVID, PRESIDENT OF EXXON RESEARCH AND ENGINEERING LIKES TO POINT OUT THAT THE UNITED STATES WINS MORE NOBEL PRIZES THAN ANY OTHER NATION. YET, WE MUST STILL BUY OUR TELEVISION SETS AND RADIOS AND MAYBE SOON OUR MICROCOMPUTERS FROM JAPAN. THAT SAYS SOMETHING ABOUT HOW WE EDUCATE AND TRAIN STUDENTS. MORE SPECIFICALLY, IT SAYS SOMETHING ABOUT HOW WE FAIL TO DEVELOP AND ENGAGE ALL THE LEVELS OF TALENT REQUIRED TO CARRY A FUNDAMENTAL DISCOVERY ALL THE WAY THROUGH TO A MARKETABLE PRODUCT. THE SEA GRANT PROGRAM PROVIDES AN EXCELLENT MODEL THAT COMBINES FUNDAMENTAL RESEARCH WITH ITS ULTIMATE APPLICATION.

I WOULD ALSO LIKE TO EMPHASIZE THE PARTNERSHIP ASPECT WHICH CHARACTERIZES THE SEA GRANT PROGRAM. SEA GRANT PROJECTS ACROSS THE BOARD-EDUCATIONAL, RESEARCH AND DEVELOPMENT, AND SERVICE-ENCOURAGE COOPERATIVE EFFORTS AMONG EDUCATIONAL INSTITUTIONS, BUSINESS-INDUSTRY, THE GOVERNMENT-LOCAL, STATE, FEDERAL-AND PRIVATE ORGANIZATIONS.

UNIVERSITY PARTNERSHIPS HAVE BEEN HIGHLIGHTED BY MANY CONFERENCES. LAST DECEMBER (DECEMBER 14-16, 1982) OVER 500 DISTINGUISHED LEADERS IN EDUCATION AND THE CORPORATE WORLD MET IN A NATIONAL CONFERENCE ENTITLED, "PARTNERS IN THE RESEARCH ENTERPRIZE". DR. HERBERT FUSFELD, DIRECTOR, CENTER FOR SCIENCE AND TECHNOLOGY POLICY, NEW YORK UNIVERSITY, PRESENTED AN "OVERVIEW OF UNIVERSITY-INDUSTRY RESEARCH INTERACTIONS". HE INTRODUCED HIS REMARKS IN THIS MANNER:

OVERVIEW OF UNIVERSITY-INDUSTRY RESEARCH INTERACTIONS

I. BACKGROUND--WHY IS THIS IMPORTANT TODAY?

AN OVERVIEW OF SUCH AN INTENSE TOPIC IS PERHAPS TOO AMBITIOUS. MY INTENT IS THEREFORE TO PLACE IT IN SOME PERSPECTIVE AGAINST THE BACKGROUND OF OUR OVERALL NATIONAL TECHNICAL EFFORT.

I CANNOT REMEMBER ANY OTHER TOPIC IN THE AREA OF SCIENCE AND TECHNOLOGY POLICY WHICH HAS ACHIEVED SUCH OVERWHELMING ATTENTION IN THE TECHNICAL AND BUSINESS COMMUNITIES IN SUCH A SHORT TIME THROUGHOUT THE INDUSTRIALIZED COUNTRIES OF THE OECD, AND EVEN BEYOND. IRONICALLY, THE CLOSEST SITUATION MIGHT BE THE CONCERN IN THE 1950'S ABOUT THE POTENTIAL IMPACT OF MASSIVE FEDERAL SUPPORT OF UNIVERSITY RESEARCH. THIS LED TO THE FAMOUS SERIES OF LECTURES BY CLARK KERR ON "THE USES OF THE UNIVERSITY" IN WHICH HE REFERRED TO "THE FEDERAL GRANT UNIVERSITY."

THE 14TH ANNUAL REPORT OF THE NATIONAL SCIENCE BOARD FOCUSED ON THIS SAME TOPIC. THEIR REPORT WAS ENTITLED "UNIVERSITY-INDUSTRY RESEARCH RELATIONSHIPS-MYTHS, REALITIES AND POTENTIALS."

AT THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE MEETING I MENTIONED EARLIER, DR. GEORGE KEYWORTH, THE PRESIDENT'S SCIENCE ADVISER, COMMENTED AS FOLLOWS ON THE SUBJECT OF UNIVERSITY-INDUSTRY PARTNERSHIPS:

"MOST ACADEMIC AND FEDERAL SCIENTISTS STILL OPERATE IN VIRTUAL ISOLATION FROM THE EXPERTISE OF INDUSTRY AND FROM THE EXPERIENCE AND GUIDANCE OF THE MARKETPLACE. ONE CAN MAKE A CONVINCING CASE THAT THIS SEPARATION IS A ROOT CAUSE OF OUR

SLUGGISHNESS--COMPARED TO SOME OF OUR MORE ENERGETIC COMPETITORS--IN TURNING RESEARCH INTO PRODUCTS."

MR. CHAIRMAN, THE REASON THAT I EMPHASIZE THE MATTER OF UNIVERSITY PARTNERSHIPS IS THAT THE SEA GRANT PROGRAM IS AN ELEGANT EXAMPLE OF PARTNERSHIPS FUNCTIONING IN A SYNERGISTIC PATTERN. ONE OF THE DRIVING FORCES IS TOWARD PARTNERSHIPS WITHIN INSTITUTIONS AND AMONG INSTITUTIONS. THE RECORD OF THE SEA GRANT PROGRAM HAS BEEN EXEMPLARY IN DEVELOPING A WIDE RANGE OF "WORKING" PARTNERS. IN FACT, THE PARTNERSHIPS DEVELOPED IN SEA GRANT PROGRAM PROJECTS CAN BE USED AS A MODEL.

HOW HAS SEA GRANT DONE SO FAR IN PRODUCING GRADUATES? AND HOW ARE THOSE GRADUATES DOING? ACCORDING TO A RECENT SURVEY (JULY, 1982) CONDUCTED BY THE NEW YORK SEA GRANT COLLEGE PROGRAM, SEA GRANT HAS EDUCATED/TRAINED NEARLY 7,000 STUDENTS, MOST OF THEM AT THE GRADUATE LEVEL, SINCE 1968. A MAJORITY OF THESE STUDENTS FOUND WORK IN WHICH THEIR SEA GRANT TRAINING WAS DIRECTLY RELATED TO THEIR JOB OR IN WHICH SEA GRANT EXPERIENCE GAVE THEM A DECIDED "EDGE" IN GAINING EMPLOYMENT. FORTY PERCENT ARE WORKING IN THE PRIVATE SECTOR, 32 PERCENT IN PUBLIC EMPLOYMENT, AND 28 PERCENT IN ACADEMIC POSITIONS.

EXAMPLES OF THE POSITIONS NOW HELD BY FORMER SEA GRANT STUDENTS INCLUDE:

-CHIEF DEPUTY ATTORNEY GENERAL OF NORTH CAROLINA.

-FORMER MANAGER OF ZAPATA CORPORATION AND NOW PRESIDENT OF THE FIRM: FISHERIES DEVELOPMENT SERVICES

-ASSOCIATE DIRECTOR OF RHODE ISLAND DEPARTMENT OF

ENVIRONMENTAL MANAGEMENT AND GOVERNOR'S ASSISTANT FOR ECOLOGY

-EDITOR "SEAFOOD BUSINESS REPORT"

-DIRECTOR, NEW ENGLAND FISHERIES FOUNDATION

-EXECUTIVE DIRECTOR RHODE ISLAND SEAFOOD COUNCIL.

CLEARLY, SEA GRANT, THROUGH ITS STUDENTS, HAS BECOME A MAJOR FACTOR IN THE MARINE SECTOR OF THIS NATION. CLEARLY, THEIR SKILLS AND ENERGY HAVE BENEFITED THIS NATION AND THIS SOCIETY.

TO CONCLUDE, LET ME RETURN TO THE SPECIFIC MATTER NOW BEFORE THIS COMMITTEE--THE REAUTHORIZATION OF THE NATIONAL SEA GRANT COLLEGE PROGRAM. I HAVE FOCUSED ON ONE ASPECT OF SEA GRANT WHICH I BELIEVE TO BE OF MAJOR IMPORTANCE. SEA GRANT'S CONTINUING CONTRIBUTION TO THE PRESENT AND THE FUTURE DEVELOPMENT OF OUR MARINE RESOURCES THROUGH ITS STUDENTS CRITICALLY DEPENDS ON A MULTI-YEAR COMMITMENT AND ON ADEQUATE FUNDING FROM THE FEDERAL GOVERNMENT.

THANK YOU FOR THIS OPPORTUNITY AND PRIVILEGE TO SHARE MY VIEWS ON THE SEA GRANT PROGRAM WITH YOU.

MR. CHAIRMAN, I URGE YOU AND YOUR COMMITTEE TO CONTINUE YOUR VALUABLE SUPPORT FOR THE SEA GRANT PROGRAM. I WILL BE PLEASED TO RESPOND TO YOUR QUESTIONS TO THE LIMIT OF MY ABILITY.

SEA GRANT STUDENTS

Results of a National Survey

(JULY 1982)

The National Sea Grant College Program Act declares that "it is in the national interest of the United States to develop the skilled manpower, including scientists, engineers, and technicians,...for the exploitation of [marine and Great Lakes] resources." This important charge to the nation's Sea Grant institutions has led to the development of new training programs, curriculum development, and, most importantly, graduation of almost 7,000 students who have been involved with Sea Grant activities in the course of their education.

But training students alone is not enough: They must find employment. Students are not only a manpower base: They are a powerful tool of direct transfer of research knowledge from the university laboratories to industry. Thus, students trained through their participation in the National Sea Grant College Program become an asset of the nation and a beneficial product resulting from the program.

At the request of the Council of Sea Grant Directors a national survey was conducted to determine how many students had been trained, what kinds of training had been given, and, perhaps most importantly, where the students went once they left college.
This survey suggests that almost 7,000 students have participated in Sea Grant either through active involvement in research or through courses, developed as a result of Sea Grant initiatives, taken in the course of their education. Included in this number are those who received baccalaureate degrees, and graduate students at the masters and doctoral levels.

"...it is the purpose of this title to provide for the establishment of a program of sea grant colleges and education, training and research in the field of marine science, engineering and related disciplines." So declares the founding legislation for the program. Sea Grant students have been broadly trained, as the program's founders suggested they should be. Marine sciences, biology and engineering are the leading fields of training, but many disciplines are represented.

The distribution of the nationwide sample of students by major field of study is:

Major Field	Percent of Sample
Biology	13%
Marine Science	12%
Engineering	11%
Marine Biology	8%
Economics	8%
Law	8%
Zoology	7%
Veterinary Science	6%
Food Science	6%
Chemistry	5%
Social Science	4%
Geology	2%
Natural Science	2%
English	2%
Public Policy	1%
Education	1%
Microbiology	1%
Environmental Science	1%
Landscape Architecture	1%
Miscellaneous	1%

An inclusive listing of major fields in which Sea Grant students have been trained includes:

Natural Science
Computer Science
Forestry
General Science
Geography
Mathematics
Pharmacy
Physics
Psychology

Biology
Animal Science
Botany
Crop Science
Ecology
General Agriculture
Horticulture
Medical Technology
Nursing

Fine Arts
Art
Fashion Design
French

Social Science
Anthropology
Asian Studies
Education
History
Liberal Studies
Public Health
Urban Studies
Sociology

Economics
Business Administration
Management

Biology (continued)
Pathology
Pharmacogosy
Physiology
Soil Science
Virology

Zoology
Entomology

Chemistry
Biochemistry

Food Science
Seafood Sanitation

Marine Science
Fisheries
Fisheries Technology
Marine, Earth, and Atmospheric Sciences

English
Communications
Journalism
Library Science
Speech

Public Policy
Government/ Internat. Relat.
Law, Sociology, Political Sci.
Marine Policy
Political Science

Engineering
Chemical Eng.
Civil Eng.
Coastal Eng.
Electrical Eng.
Environmental Eng.
Industrial Eng.
Ocean Eng.

Most Sea Grant students find employment in the private sector (nearly 40%) while a lesser number work in governmental capacities (slightly over 30%) and still fewer remain in the academic sector (over 25%). Of those who found work in the public sector, nearly two-thirds are employed by state or local governments. Most students (estimated at 61% of the total) found work in which their Sea Grant training was directly related to their job or in which their Sea Grant experience gave them a decided "edge" in gaining the employment.

Private sector occupations were less related to Sea Grant experience, perhaps reflecting the immature state of development of the marine industrial sector.

Employment Experience of Sea Grant Students

	Percent of Sample	
Private Sector	40%	
Directly Related to Sea Grant Experience		8%
Not directly Related to Sea Grant Experience, but Marine-Related		12%
Not Marine-Related		20%
Public Sector	32%	
Federal government		12%
State government		15%
Local government		5%

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(It is estimated that 61% of public/private sector employment is in occupations related to the student's Sea Grant experience)

Academic and Not-For-Profit Research Sector	28%	
Faculty		18%
Other		10%

In a more detailed study of the impact of Sea Grant research projects (Utterback and Linskey, 1982) it was found that of 19 research projects which led to a commercial impact, over half the students participating in the activities went into the private sector, with only about a quarter of them in each of the public and academic sectors. These data lead inescapably to the conclusion that students are not only a resource in the nation's pool of skilled persons, but also to their powerful importance in technology transfer.

It may only be concluded, therefore, that Sea Grant students have become a major factor in the marine sector of the nation and that the benefit to the nation and society from the skills they have obtained meets the expectations set for the program.

Senator PELL. Thank you very much, Dr. Pelczar. Mr. McLean.

Mr. McLEAN. Senator, I am very pleased and flattered to be invited to speak to this group. The Florida Institute of Technology, FIT, is located on the east coast of Florida on the Indian River and Jensen Beach. It is a hands on or an applied science campus. It was acquired in 1972. The student body, which is coed, has increased from 18 people to over 1,000 in an 11-year period.

During the current economic crunch, FIT has continued to expand its facilities, faculty, and student body. We have a fleet of seven research and study vessels from 22 to 65 feet, which have been built up to first-class shape mainly by our staff and students. Today they are all running on a 5- to 6-day week in the teaching of programs.

The marine education given at FIT-Jensen Beach, Fla., whether used on ship or shore, is of great value to the Southeast Atlantic and Gulf States.

Surprisingly, Florida is not generally recognized as a maritime State, yet it has the longest coastline in the U.S.A. Another statistic not generally known is that the cargo handled in the southeast and gulf ports is double that of the master ports of New England and the Mid-Atlantic States. The Port Authority's document shows 6,919 million tons versus 3,544 million tons.

Florida's sea grant concurred in the findings of the University of Jacksonville, Purdue, and local market surveys that the need for marine mechanics—inboard, outboard, and diesel—would increase by 40 percent through 1985. The need for underwater technologists and life support technicians will remain high as offshore Florida sites are developed.

School systems are not interested in setting up "in depth" courses of these kinds. Outboard laboratories are most expensive. Diesel labs are even more so. In addition, there are the problems of exhaust gases and explosive fuels which mandate separate school buildings.

Florida's sea grant viewed this situation as one that could be solved by supplying seed money to FIT to ascertain the feasibility of setting up both certificate and college credit courses at FIT for underwater technologists. The results were far beyond expectations. Grant one—the underwater technology grant, the first FITC grant set up in 1976—is completely self-sufficient, supplying divers and technicians with associate degrees, primarily to the United States and North Sea. We turn them out at the rate of 50 a year. In addition, some graduates are working for American companies operating in Southeast Asia, the North Sea, Africa, et cetera.

Major contractors utilizing these services include Ocean Engineering International, Underwater, Santa Fe Diving, et cetera, et cetera.

FIT students are or have been employed with companies such as these as tenders, divers, life support technicians, remote control vehicle operators, submarine pilots, nondestructive testing technicians, welders, and supervisors. Although the majority of our graduates seek employment with commercial diving firms involved with working in the offshore oil industry, there is also a significant number working in related fields.

Some examples are the Harbor Branch Foundation in diving research; Duke University; there was one of FIT's graduates that recently went down to 2,000 feet; and hyperbaric oxygen therapy at the JoEllen Smith Hospital in New Orleans. In addition, we are on call by the community at any time there is a problem with bends. The divers are rushed to our hyperbaric chambers.

Grant two was the outboard technology problem. Outboard motors were originally designed to replace oars and were attached to the boat transom with thumb screws. Today the outboard motors have boats designed to advanced engine capabilities. The ratio of horsepower per pound of engine is state of the art, with electronic ignition, tuned exhaust, and outboards up to 300-horsepower plus.

Outboards are used for every purpose, heavily commercial as well as recreation. The concept of any handyman small motor shop being able to repair these new motors is just not so. It requires a technician trained in theory as well as "hands on" exposure.

FIT in conjunction with Florida sea grant set up an advisory committee which more than confirmed the need for high level technical training. With $93,000 seed money from Florida sea grant, FIT was able to obtain from donors the matching funds for the laboratories. Dr. Ralph Evinrude supplied 50 new motors of all sizes and horsepower, including those of his competitors.

The results of this collaboration between FIT and Florida sea grant include training 40 outboard technicians a year, many to stay in the Florida-Southeast Atlantic area.

FIT has trained the marine officials of the Bahamian Government and many from South America and Third World nations. We say that exporting education instead of weapons is not a bad goal. The methods, layout, and curriculum are available to any agency directed to us by Florida sea grant.

In this last semester, we had people at this school from 21 different countries.

Grant Three: Florida spends millions of dollars a year to attract tourists, full or part time residents, and light high-tech industries. These newcomers expect, in addition to the marvelous climate, good roads, drinking water systems, irrigation systems, trains and trucks to carry products, boats for commerce, for sport, and commercial, and fuel for all types of engines, mainly diesel.

To meet their expectations, a steady supply of diesel technicians is mandatory. Market research was conducted, and owner-operators of some 2,000 diesel engines went on record as saying that trained diesel mechanics were urgently needed. FIT made their findings known to Florida sea grant, requested seed money to supplement the facilities received from industry, private donors, and foundations. sea grant supplied $34,000. FIT now has two diesel laboratories with one diesel engine for every two students, and graduates about 40 diesel technicians a year.

Last September two new courses were set up with an associate degree in diesel technology and an associate degree in marine propulsion. In addition, night classes and introduction courses are given each year to approximately 160 technical students.

Florida sea grant performs a very necessary role with us. Before investing time and money to ascertain the need for technical courses or programs, FIT collaborates with FSG to see if the need is genuine, if it warrants action, has it been attempted before, and by whom? If the need does warrant action, review existing facilities of schools that might take it on. If none, proposals are solicited by Florida sea grant, reviewed, evaluated, and funded. As far as FIT is concerned, the results speak for themselves.

Technical education is a very dynamic field. Technocracy increases in a logarithmic curve. The time between a technical breakthrough and the need for technicians to manufacture, install, set up, and maintain it has decreased from years to months.

The stigma of blue collar, "hands on" is rapidly disappearing. To repair computers and interfacing equipment today, the technician sits in his central office and a distant computer transmits by phone the pattern of signals that tells what the problem is. Approximately 20 field technicians are needed for every design engineer. A need has developed for associate degree technicians that learn "hands on" with the potential for supervision and management.

More cooperation is needed. Between industry and academics we do not see enough professors in the industrial plants, and we do not see enough industrialists in colleges. They have got to get together more than they do now.

The economic summary of FIT-Sea Grant is as follows: Students do not come to FIT primarily to take arts or humanities; they come to learn marine, oceanographic, diesel, outboard motor, environment, and underwater technologies. Florida Institute of Technology has averaged 800 students per year during the 6-year period of the Florida sea grants. Total FIT funding from Florida sea grants has been $399,000. Without going into all of the numbers here, it comes out that the total money brought into the Florida economy by students from all States in the United States and foreign countries is $31,200,000.

We have added no multiplier effect to that, nor the kind of money that firms have saved by having technicians trained for them.

Florida Institute is proud to be a member of this Florida sea grant team. It is an excellent example of the way that industry, education, and Government should work together, and if I may be permitted an observation, we do not have the luxury of going along the way we have been. The frame of reference is breakthroughs in technologies versus people to put these breakthroughs to use.

Example: One of the prime sciences made no advancement whatsoever for over 50,000 years, the science of illumination. The earlyman in his cave burnt sticks for illumination; we burned oil; we burned fat; we burned gas. There was no breakthrough in illumination until the late 1890's. When Edison developed the electric light. Today, in contrast, when we have a breakthrough in computer technology or in microchip or in microprocessors, it is utilized within weeks.

[The prepared statement of Mr. McLean follows:]

STATEMENT OF DEAN E. E. TEALEY
Executive Director
Florida Institute of Technology

DELIVERED BY WILLIAM P. MC LEAN
Acting Director
Evinrude School of Marine Technology
Florida Institute of Technology

On

AUTHORIZATION

of

NATIONAL SEA GRANT COLLEGE PROGRAM ACT

BEFORE THE SUB-COMMITTEE

Education, Art and Humanities
of the Committee on Labor and
Human Resources

April 7, 1983
Washington, D. C.
10:00 a.m.

The Florida Institute of Technology (F.I.T.) is located on the East Coast of Florida on the Indian River at Jensen Beach. A "hands on" or, an "Applied Science", accredited, non-profit, degree granting college. The Marine campus was acquired in 1972. The student body (coed) has increased from 18 to over 1000 in an 11 year period. During the current economic crunch F.I.T. has continued to expand its facilities, faculty and student body and 85-90% of its graduates are gaining employment in their respective fields.

A fleet of seven (7) research and study vessels (22' to 65') has been built up and put in first class condition mainly by staff & students, over the last few years. Today they are all running on 5-6 day week schedules. All vessels are equipped with the latest electronic navigation equipment and teaching facilities.

The Marine education given at F.I.T., Jensen Beach, whether used on ship or ashore, is of great value to the southeast Atlantic and Gulf states. Surprisingly, Florida is not generally recognized as a "Maritime" state, yet it has the second longest coastline in the U.S.A.. Another statistic not generally known is that cargo handled in the Southeast and Gulf ports is double that of the "Master Ports" of New England - Mid-Atlantic States. (See Association of Port Authorities Document - 6919 million ton vs. 3544 million ton)

Florida Sea Grant makes it abundantly clear to applicants for funding that the money supplied by Sea Grants is "seed money" to aid in getting Marine projects started that will benefit the state of Florida, its industries, and its taxpayers. The projects must be completed or self-sustaining after two years. F.I.T. obtained matching funds equal to or more than those received from Florida Sea Grant and has made each program self-sustaining.

Florida Sea Grant concurred in the findings of University of Jacksonville, Purdue, and local market surveys that the need for Marine Mechanics (both inboard and out) would increase by 40% through 1985. The need for underwater technologists and life support technicians would remain high as offshore Florida sites are developed.

School systems are not interested in setting up in-depth courses of these kinds. Outboard laboratories are most expensive. Diesel labs are even more so. In addition, there are problems of exhaust gases, and explosive fuels which mandate separate school buildings. Several industries set up diving training schools, primarily to fill there own needs. Florida Sea Grant viewed this situation as one that could be solved by supplying "seed money" to F.I.T. to ascertain the feasibility of setting up both certificate and college credit courses at F.I.T. for Underwater Technologists. The results were far beyond expectations.

Underwater Technology

The Underwater Technology program (first F.I.T. Sea Grant set up, 1976) is completely self sufficient, supplying divers and technicians with associate degrees primarily to the U.S. and the North Sea. In addition some graduates are working with American Companies operating in Southeast Asia, North Sea, Africa, etc. Major contractors utilizing F.I.T. divers include Oceaneering International, International Underwater Contractors, Santa Fe Diving Services, Taylor Diving and Salvage, McDermott Divers, Martech International, Subsea International and Solus Ocean Systems.

F.I.T. students are or have been employed with companies such as these as tenders, divers, life support technicians, remote control vehicle operators, submarine pilots, non-destructive testing technicians, welders, or supervisors.

Although the majority of our graduates seek employment with commercial diving companies involved with the offshore oil industry, there are also a significant number working in other related fields. Some examples include: research diving - Harbor Branch Foundation; diving research - Duke University (one of F.I.T.'s graduates recently participated in the record dive at Duke to over 2000 feet) and hyperbaric oxygen therapy at JoEllen Smith Hospital in New Orleans, Louisiana.

Outboard Technology

Outboard motors were originally designed to replace oars and were attached to the boat transom with thumb screws.

Today the outboard motors have boats designed to advanced engine capabilities. The ratio of HP per pound of engine is a state of the art, with electronic ignition, tuned exhausts and output to 300 HP. Outboards are used for every purpose, heavily commercial as well as recreational. The concept that any "small motor" shop being able to repair these new motors is just not so. It requires a technician trained in theory as well as "hands on" exposure.

F.I.T. in conjunction with Florida Sea Grant set up an advisory committee which more than confirmed the need for high level technical training. With $93,000 "seed money" from F.S.G., F.I.T. was able to obtain from donors the matching funds for the labs and from Dr. Ralph Evinrude, fifty new motors of all sizes and horsepower including those of his competitors.

The results of this collaboration between F.I.T. and F.S.G. include training forty (40) Outboard Technicians per year, many to stay in the Florida-Southeast Atlantic area. F.I.T. has also trained the Marine officials of the Bahamian government, and many from South America and third world nations. Exporting education instead of weapons is not a bad goal. The methods, layout and curriculum are available to any agency directed to F.I.T. by F.S.G..

A survey taken for a government agency showed that the F.I.T. graduate outboard technicians were either working in that field or moved up to better marine positions. The chief instructor at the Evinrude School in Miami is an F.I.T. graduate. Others have worked in experimental shops and still others in outboard research and development. Several have become managers of large marinas. F.I.T. is continually solicited for its graduates. "Seed money" received from Florida Sea Grant $93,000.

Diesel Technology

Florida spends millions each year to attract tourists, full or part-time residents, and light Hi Tech industries. These newcomers expect (in addition to the marvelous climate) good roads, drinking water systems, irrigation systems, trains and trucks to carry products, boats for commerce or sport, fuel for all types of engines (diesel & outboard). To meet their expectations, a steady supply of diesel & outboard technicians is mandatory. A market research was conducted and owner-operators of some 2000 diesel engines went on record as saying that trained diesel mechanics were urgently needed.

F.I.T. made their findings known to Florida Sea Grant and requested "seed money" to supplement facilities received from industry, private donors, and foundations. Sea Grant supplied $34,000. F.I.T. now has two (2) diesel laboratories (one diesel engine per two students) and graduates about 40 diesel technicians per year. Salaries vary from 15 to 20 thousand a year. Last September two new courses were set up, an associate degree in Diesel Technology and an associate degree in Marine Propulsion (diesel and outboards). In addition, night classes and introduction courses are given each year to approximately 160 technical students.

Florida Sea Grant performs a very necessary role. Before investing time and money to ascertain the need of technical courses or programs, F.I.T. collaborates with F.S.G. to see if the need is genuine, if it warrants action, has it been attempted before, and by whom. If the case does warrant action, review existing facilities or schools to take it on. If none, proposals are solicited by F.S.G., reviewed, evaluated, and funded. As far as F.I.T. is concerned, the results speak for themselves.

Technical education is a very dynamic field. Technocracy increases in a logarithmic curve. The time between a technical break through and the need for technicians to manufacture, install, set up and maintain it has decreased from years to months.

The stigma of blue collar, "hands on" is rapidly disappearing. To repair the computer and interfacing equipment today, the technician sits in his central office and the distant computer transmits by phone the pattern of signals that tell what the problem is. You need approximately twenty (20) service or field technicians for every design engineer. Salaries are commensurate with skill.

Economics Summary

The economics of the team effort of Florida Institute of Technology and Florida Sea Grant are easy to demonstrate.

Students do not come to F.I.T. primarily to take arts or humanities. They come to learn Marine, Oceanographic, Diesel, Outboard Motor, Environment, and Underwater Technologies.

Florida Institute of Technology has averaged 800 students per year during the 6 year period of the Florida Sea Grants.

Total F.I.T. funding from F.S.G.	$ 399,000.00
Average college costs & fees per year per student	6,500.00
Average number of students per year	800
Total costs & fees per year	$5,200,000.00
Number of years of Florida Sea Grants	6
Total money brought into Florida economy by students from all states in the U.S. and foreign countries.	$31,200,000.00

Florida Institute of Technology is proud to be a member of the Florida Sea Grant team. It is an excellent example of the way that industry, education and government should work together.

Senator PELL. Thank you very much indeed. Dr. Trabant, I was much interested in your thought about the real wealth of our Nation, the strength of our Nation; I know I have often said that to my mind the strength, the wealth of our Nation is the sum total of the education and character of our people.

And I am glad to see that we think alike. I think many of us who are involved with education do. I have one question that really I wanted to ask the four of you for a reaction. And that is, in your view or your opinion, do you believe that the local resources, no matter whether they are local government or private, will take up the slack if sea grant goes out of business?

Mr. TRABANT. I can certainly answer for Delaware. At the moment in the State of Delaware in higher education there is less money at the moment being planned to be allocated to higher education for next year than the current year by the State of Delaware. The only increase will be funding mandated by the State's plan with the Office of Civil Rights under the title VI program, which amounts to several hundred thousand dollars.

Therefore, there would be absolutely, in my opinion, no possibility for the State of Delaware to pick up the funding for the university in its marine program if the sea grant program is not funded.

Senator PELL. Feeling aside, did I hear you correctly; did you say the Office of Civil Rights is being expanded in Delaware?

Mr. TRABANT. The program under the title VI program, sir, in Delaware requires the expenditure by the State of several hundreds of thousands of dollars in terms of scholarships, new academic programs at the Delaware State College. And those were agreed to in the title VI plan as negotiated between the Office of Civil Rights and the State of Delaware.

And those funds, those additional funds are currently in the budget recommendations of the State. But for the regular academic programs, it is level funding or less than level funding.

Senator **Pell**. That was just an aside. I appreciate your reaction, very much.

Dr. Rorholm, I am as much struck as I am sure you were by Mr. McLean's statistics where for an investment of $399,000, $31,000,000 had been added to the Florida economy. This is the sort of cost-benefit ratio that I wish could come from all over the country because I think it would strengthen the hands of those of us who believe in these programs.

Do you have any particular thought on this question of what would happen at home in Rhode Island if the sea grant program was eliminated?

I know we asked Dr. Knauss that question earlier, but I would be interested in your reaction.

Mr. **Rorholm**. I think that very important work would simply stop. First of all, the State or the localities do not have the money. Second, even if they did, the type of work sea grant does, the interaction between research, teaching, and working with users in the field cannot be done by a governmental unit, be it State or Federal. This is the important lesson we have learned from the workings of the Hatch Act and the Agricultural Extension Service. Universities can serve the role of translating information from industry to Government and vice versa but Government units themselves cannot do it.

Senator **Pell**. I would just like to interrupt the proceedings to say that I welcome the long time chief clerk of this committee, Stewart McClure, who has not been with us for many, many years. He has come back home after approximately 20 years of absence, Stewart McClure.

Thank you very much, indeed.

Dr. **Pelczar**. My comment, Mr. Senator, would be that the success of the program has been through its partnership aspects: The State and the Federal government and the university and the business and industry and to pull one of the partners out would have a dramatic, detrimental effect on the program.

And I think that the results, the benefits that accrue from the program are not simply regional. This is a national asset that we are concerned with. So I think that there is an obligation and I think that to keep the team together, so to speak, will make it effective. If you pull somebody out, it will go to some level of deterioration.

Senator **Pell**. Mr. McLean, what would happen to you if sea grant programs were eliminated?

Mr. **McLean**. Well, I think it would slow down our progress. We would view the next step we are ready to go into would be robotics. That would slow that down fast, but I feel that——

Senator **Pell**. Would be what?

Mr. **McLean**. Robotics.

Senator PELL. Robotics. Thank you.

Excuse me. How can you mend an outboard with robots?

Mr. MCLEAN. Senator, I would believe anything with the strides we have made. If robots return the manufacture of small outboards to this country, it could be a step in the right direction. As you probably know, some of the small outboards are now being built in Japan. But to answer your original question, I think that teamwork is the key word here. Florida sea grant has always filled the role as coordinator; with them taken out of the picture, I would be very unhappy to see that.

Senator PELL. But in your case, do you think that private industry would pick it up because you are dealing more, as you put it, on a "hands-on" basis.

Mr. MCLEAN. By being part of a government team, it gives you leverage. When we go to a donor and say, Florida sea grant has recognized that what we say is needed—a diesel school or diving school—the fact that the Government has looked into it and agreed, that helps us to get donors and to get industry to cooperate and put these new concepts into being.

Without the Government backing, our job is going to be a lot harder.

Senator PELL. Thank you. And thank you gentlemen very much indeed for taking the time to be with us today. I am very proud of each one of you.

Now, our second panel: Mr. Edward Brainard, president of ENDECO; and Mr. Gerry Seifert, general counsel for Maritime Affairs, House Merchant Marine and Fisheries Committee.

Welcome and we will start off, I guess, in alphabetical order. Mr. Brainard.

STATEMENTS OF EDWARD C. BRAINARD II, PRESIDENT, ENDECO, INC., MARION, MASS.; AND GERALD SEIFERT, GENERAL COUNSEL FOR MARITIME POLICY, HOUSE MERCHANT MARINE AND FISHERIES COMMITTEE, U.S. HOUSE OF REPRESENTATIVES, WASHINGTON, D.C.

Mr. BRAINARD. It is a pleasure to be here, Mr. Chairman. My name is Edward Brainard. I am president of Endeco, Inc. Our company designs and manufactures marine instruments and towed underwater systems. Our equipment is used worldwide.

I have been a member of the State industry advisory council at MIT and have served there as chairman from 1979 to 1981. Our company has also been a member of the MIT Sea Grant Collegium from its inception.

Let me give you a few examples of how the sea grant program has benefited our company. Recently we contacted the University of Rhode Island to obtain current information, water-ocean current information off Cape Hatteras. We were preparing a proposal for the offshore oil companies for operation in that area. We needed the current information to design an offshore telemetering current meter buoy.

Recently we contacted the University of New Hampshire to obtain information on unmanned, remote, autonomous, free swimming vehicles. This information was very important to us to help us in our planning for the future in the developments in our company.

We have had five projects with the MIT sea grant program over the last 8 years which we have cosponsored. These range from market studies for marketing of the bay scallop, analysis of directional wave measuring devices, analysis of techniques to reduce wave and mooring noise, and current meters, the investigation of a technique to use fluorescents from the air, from an aircraft to detect red tide in large areas. This work was not successful, but it led to the development of the "petro-track" towed fluorometer system, which was used at the Amoco Cadiz oilspill in Brest, France, in 1978 to define the three dimensional dispersion of the oilspill.

That unit is now being used in the United States, Canada, Japan, and the Philippines. We also have carried out a study recently with MIT in their biomedical instrumentation laboratory related to trying to detect when a radar operator or a sonar operator was going to fall asleep by measuring the temperature of his tympanic membrane within the ear canal.

In all, we have not always achieved the desired direct results, but each project has a positive and measurable outcome.

I would like to make a few comments on the present day sea grant program. I do think it is inappropriate to fund such programs as shrimp recipes. I think it generates a bad name for the program, and I think that can be done by the fishing industry.

We have heard much evidence here and before on the return on investment from the sea grant program. This is good evidence, and it is convincing. One thing should be kept in mind. There is cross-fertilization. We have heard of the space program stating that cross-fertilization from that program justified more expenditures in that area. Now we can document cross-fertilization from our work in the sea grant program in the ocean.

Just one example: We have started a new medical group using techniques of sonar and packaging that we use in the ocean to make a new product called an acoustic otoscope to detect fluid in the middle ears of children.

International competition: I travel considerably on a worldwide basis and have the opportunity to see the capabilities of other nations. The United States has an unbelievable capability and potential, and we have a growing international threat. That is the availability of foreign labor to manufacture goods at a much lower price.

For example, think of the 1 billion-plus individuals in the People's Republic of China who are now entering the world labor force. This input is just starting to be felt. We cannot exclude their products since we are in a worldwide, interdependent economic system which is a vital part of maintaining global stability. Obviously, if we have competition in one area, we must excel in another.

We have a major lead in sophisticated ocean systems, in ocean engineering capabilities. We must press on to maintain this lead. The sea grant plays an important role in the supremacy.

Closer ties with industry: MIT has developed a unique program, the Collegeum, to generate cooperation in exchange with industry. They have about 100 member companies and run numerous seminars to allow their researchers to report and exchange ideas with industry. This feedback is vital to insuring the researcher is properly tuned to the real world problems and that the industrial community knows the work of the researchers.

Many friendships are built between industry and the academic community through this exchange, adding a vitality to the sea grant program.

Another item is the size and duration of programs. I believe that the programs supported by sea grant should be small in nature, such as $100,000 or less, and that their duration should not exceed 3 years. More emphasis must be stressed on creativity and the use of brains in these programs to generate something as an output which can be considered as a national asset.

Funding of hard technology: There are now, I believe, 29 institutions which have sea grant funds on an annual basis. Funding distribution has become routine and appears quite steady State to the participating institutions. A reevaluation of this procedure is needed. Continuing advisory services—that is, prolonged ones—and repeat studies in soft technology areas must be avoided.

Proposed programs should show greater matching funds from outside sources such as industry. This outside funding will improve and guarantee the value of the sea grant expenditures.

Finally, one comment is on publishing. It will be difficult to obtain industrial funding under sea grant's present publication policies. When private capital is invested in research, some guarantee of confidentiality must be given. I recommend that when industry provides 50 percent or greater matching funds, the supporting industrial group can have the option to withhold publication for up to 3 years.

Finally, I am 100 percent for the reauthorization of the program, and I am concerned about who would fill the gap if we did not have an efficient and creative sea grant program. Thank you.

[The prepared statement of Mr. Brainard follows:]

TESTIMONY SUBMITTED

by

Edward C. Brainard II
President
ENDECO, INC.
Marion, Massachusetts, U.S.A.

INTRODUCTION

My name is Edward C. Brainard II. I am President of ENDECO, INC. a company which designs and manufactures marine instruments and towed underwater systems. Our equipment is used worldwide by energy related industries for siting offshore and coastal facilities and for real-time monitoring of the environment relative to currents and waves. Our business was founded in 1960 at the start of our nation's major awareness of the potentials of the ocean. Presently, more than fifty percent of our business comes from abroad.

For many years I have been a member of the M.I.T. State/Industry Advisory Council and served as Chairman from 1979 to 1981. ENDECO, INC. has been a member of the M.I.T. Sea Grant Collegeum from its inception. This contact with M.I.T. has given me some definitive ideas about the National Sea Grant Program. I am very pleased to be asked to participate this morning as you consider legislation to reauthorize the Sea Grant Program, S.655, which was introduced by Senator Pell.

THE SEA GRANT PROGRAM

The fundamental objective of the Sea Grant Program is to educate and train our young people in an understanding and wise use of our oceans. The program has developed a valuable pool of knowledge in the form of research and literature, as well as professorial consultants and trained graduates for job placement within the ocean industry.

Visualize with me the ocean. Think of the ocean as a vast unknown resource covered with an almost opaque blanket of seawater. Our knowledge of the resources below the surface is only just beginning.

Move along in a vessel and try to probe the depths with sonar, magnetometers, gravimeters, blue-green lasers, electromagnetic radiation or probes. Still the question reoccurs, do we really know what is there? Are there valuable assets we are missing which could help our country solve the energy problems, provide food resources, chemicals, drugs from the sea, etc.? Are we polluting the ocean irreversibly? What will happen if we carry out the proposed construction? Will our subsea atomic waste storage plan be safe?

These vital questions can only be answered through more understanding and discoveries about our marine environment and ecology. This is where Sea Grant has been and must be allowed to continue to meet the challenge and help develop this pool of knowledge.

Let me give a few examples of the availability and use my company has made of this fountain of knowledge:

1. We were asked by several major oil companies to propose a radio telemetering current monitoring buoy system for use off Cape Hatteras in 6,500 ft depths. The Gulf Stream impinges the proposed area for oil drilling operations. The drilling operations could not continue during periods of high currents and the operators need early warning before the Gulf Stream reaches the drilling vessels.

   We needed to know the expected current profiles for this area. The data was immediately available through the University of Rhode Island, Department of Physical Oceanography. They receive major support from the Sea Grant Program.

2. We wanted to obtain an in-depth review of the present developments in the field of unmanned, remote, autonomous, free-swimming vehicles. Within a day we received detailed information from the University of New Hampshire on this field including their work, work of others in the U.S.A., and work being carried out abroad. This information has been an important input in our future planning for product development.
3. We have had five projects with the M.I.T. Sea Grant Program over 8 years where we co-sponsored the projects. The results are listed below:
    a) To carry out a market study for the distribution of Bay Scallops grown by aquaculture. We did not proceed with this project, but hired the investigator 7 years later to head up our new medical instrumentation group, ENDECO MEDICAL, INC.
    b) To study a new method for measuring wave direction which was developed by ENDECO, INC. The study analytically and by model tests verified the capabilities of the system. ENDECO, INC. used this base of knowledge to develop and market worldwide another technique with greater potential.
    c) To study a technique developed by ENDECO, INC. to isolate a shallow water current meter from wave and mooring noise. The project provided analytical and model verification of the design with helpful insight for future developments and uses of the concept. The student now works for a major firm in the CADCAM field specializing in software development in the marine field.

The project inspired the supervising professor who has gone on to make valuable contributions in the prediction of the dynamics and design of mooring systems and fish otter trawls.

d) To study the fluorescence characteristics of organisms responsible for Red Tide to see if an airborne instrument could be developed to map Red Tide by remote sensing. The project was unsuccessful, but the fluorescence techniques developed during the project allowed ENDECO, INC. to develop the towed underwater PETRO-TRACK System which was successfully used to define the three-dimensional dispersion characteristics of the "Amoco Cadiz" oil spill off Brest, France in 1978. This system is now used in the United States, Canada, Japan and the Philippines.

e) To study a method to detect when a subject will fall asleep based on measuring the temperature of the tympanic membrane within the auditory meatus. This project did not provide conclusive confirmation of the technique, but indicated necessary instrumentation development and showed that an operator of a computer terminal undergoes considerable stress after prolonged interaction with the machine. This finding may lead to a new product area for our company.

In all, we have not always achieved the desired direct results, but each project has had a positive and measurable outcome.

COMMENTS ON THE SEA GRANT PROGRAM

Project Type: Careful consideration must be given not to fund programs which are inconsequential or which should be and will be funded by others. The funding of shrimp recipes is inappropriate. Let the Commercial Fishing Industry do that!

Return on Investment: You have heard convincing evidence from other testimony that the Sea Grant Program is showing good return on investment for our country. I don't think the full impact of this return is measurable.

Our nation is acutely aware of the cross-fertilization of the space program into other technical areas. Now we have examples of how our ocean work is having a similar effect.

Our company has started a medical instrumentation subsidiary to use our ocean talents in medicine. Our first product, an ACOUSTIC OTOSCOPE for detection of fluid in the middle ear of a child, uses sonar techniques to accomplish this task.

I am sure many such cross-fertilizations could be documented which could further justify the reauthorization of the Sea Grant Program.

International Competition: I travel considerably on a worldwide basis and have the opportunity to see the capabilities of other nations. The U.S. has an unbelievable capability and potential and we have a growing international threat; that is the availability of foreign labor to manufacture goods at a much lower price. For example, think of the 1 billion plus individuals in the People's Republic of China who are now entering the world labor force. This input is just starting to be felt. We cannot exclude their products since we are in a world-interdependent economic system which is a vital part of maintaining global stability. Obviously, if we have competition in one area, we must excell in another. We have a major lead in sophisticated ocean systems and ocean engineering capabilities. We must press on to maintain this lead. Sea Grant plays an important roll in this supremacy.

Closer Ties With Industry: M.I.T. has developed a unique program, The Collegeum, to generate cooperation and exchange with industry. They have about 100 member companies and run numerous seminars to allow their researchers to report and exchange ideas with industry. This feedback is vital to ensuring that the researcher is properly tuned to real-world problems and that the industrial community knows the work of the researchers. Many friendships are built between industry and the academic community through these exchanges, adding a vitality to the Sea Grant Program.

Size and Duration of the Programs: I feel the greatest return for the Sea Grant Program will be obtained by keeping funded projects under $100,000 and definitely for no longer a duration than three years. Use of brains and creative thinking must be stressed. We are beyond the days of solving problems with shear massive expenditures. Our nation's future potential now lies in its creative thinking. Through a group such as the M.I.T. Collegeum, a potentially valuable new idea will quickly be appreciated by industry, and industry will be willing to fund a good concept, if economic value exists.

Funding of Hard Technology: There are now 29 institutions which have Sea Grant Programs funded on an annual basis. Funding distribution has become routine and appears quite steady state for the participating institutions. A reevaluation of this procedure is needed. Continuing advisory services and repeat studies in soft technology areas must be avoided. Proposed programs must show greater matching funds from outside sources, such as industry. This outside funding will prove and guarantee the value of Sea Grant's expenditures.

Publishing: It will be difficult to obtain industrial funding under Sea Grant's present publication policies. When private capital is invested in research, some guarantee of confidentiality must be given. I recommend that when industry provides 50 percent or greater matching funding, the supporting industrial group can have the option to withhold publication for up to three years.

SUMMARY

You are being asked to review a very successful program for reauthorization. Periodic reauthorization provides a valuable opportunity for reappraisal and is necessary to ensure a continuing and dynamic program. You have heard many well documented presentations on the success of the Sea Grant Program. I hope you will continue to look upon the Program favorably and consider some of my suggestions. I am concerned about who would fill the gap if we didn't have an efficient and creative Sea Grant Program?

Respectfully submitted

Edward C. Brainard II

Edward C. Brainard II

Senator PELL. Thank you very much, Mr. Brainard. Mr. Seifert.

Mr. SEIFERT. Thank you, Senator Pell.

Senator PELL. Welcome to this side of the Capitol.

Mr. SEIFERT. Thank you. It is a rare opportunity for a member of the staff of the Congress on either side to appear before a committee except during markups when the circumstances are completely different.

As such, I think it would be important for the record to note that I am not here representing the Committee on Merchant Marine and Fisheries of the House of Representatives, but merely in my own capacity, even though I am sure I am here because of my position.

I am a graduate of one of the programs funded originally by sea grant. I am a graduate of the marine affairs program at the University of Rhode Island.

Senator PELL. What year did you graduate?

Mr. SEIFERT. 1977, sir.

Senator PELL. Thank you.

Mr. SEIFERT. I would like to go back and offer my testimony, with the permission of the Chair, for the record.

Senator PELL. All testimony that has been submitted will be included in the record.

Mr. SEIFERT. I will summarize very briefly what is contained in my testimony and disgress a bit, if I may, based upon what I have heard this morning.

In summary, I sought a change of professional approach. The marine affairs program at the University of Rhode Island provided me with the opportunity to broaden my base of experience and education, which was in law, to a field which I thought required the type of training I could bring to it; and if augmented by the type of curriculum which was provided in that program, would lend support to my goals as well as allowing me to lend my support to the new policies and missions of ocean resource development.

Following my completion of studies at the University of Rhode Island, and in part because of the research I had undertaken, I was able to obtain employment with the Committee on Merchant Marine and Fisheries, first thanks to Dr. Rorholm giving me an A in economics, as an economist for the Subcommittee on Merchant Marine, later as counsel, and now as General Counsel for Maritime Policy for the Full Committee on Merchant Marine and Fisheries.

In my capacity, I note the usefulness that can be made of graduates or near graduates of the program as interns, sea grant interns who come and work with the committee to great benefit to the committee and its members.

And I would parenthetically add that if the funding for the sea grant program would end and with it the likelihood of the ending of the internship program between the sea grant colleges and the Congress of the United States; my request to several of the institutions who furnish us with interns for an intern or a fellow who specializes in marine transportation would likely not be available. We have had fellows and interns from the sea grant program who have assisted the committee in the oceanography area, in the fisheries area, and other resource development areas.

But never has there been one who has been interested in or has done any studies to any extent in marine transportation.

This is my point of digression, Mr. Chairman; as one who works in the marine transportation field, which is admittedly one of the major concentration areas in ocean studies and one of the identified areas for the sea grant program, we have found that there is very little attention paid by the universities to ocean transportation, the policy aspects of ocean transportation.

If the shift of financing, of funding were made as is proposed by the administration to the local governments or to the local universities, then the kinds of pressures which are applied in the development or in the creation of marine policy is likely to occur at all levels of studies involving ocean policy.

So where the squeaky wheel is will go the money. Consequently, the development of a broad policy base upon which Congress can make the kinds of determinations that must be made in this burgeoning area of ocean resource development which includes ocean transportation will, in my estimation, be completely lacking.

I will not pursue my digression any further, and leave everything else to questions.

[The prepared statement of Mr. Seifert follows:]

STATEMENT OF GERALD SEIFERT
GENERAL COUNSEL FOR MARITIME POLICY
HOUSE COMMITTEE ON MERCHANT MARINE AND FISHERIES

My name is Gerald Seifert. I am General Counsel for Maritime Policy, Committee on Merchant Marine and Fisheries, House of Representatives. I appreciate the opportunity to share with you my experience as an alumnus of one of the Sea Grant Programs.

In 1976, I was an attorney engaged in the practice of law, concentrating in the area of regulated industries. I had served as a regulator, as Chief Deputy Commissioner of the Indiana Public Service Commission and proceeded thereafter to represent municipalities and others before regulatory bodies. It occurred to me that the one area of regulation which was fast developing and in which I had little or no knowledge was in that vast, yet-to-be exploited field involving the oceans.

Without burdening you with the way in which I made my choice of institutions to broaden my knowledge and experience base, I enrolled in the Master of Marine Affairs Program at the University of Rhode Island, one of the older National Sea Grant college programs. I must say that the design of the program at Rhode Island was, at least for me, a perfect fit. The curriculum and requirements for completion necessitated exposure to the several disciplines which that faculty views as essential. Therefore, the course work and

RESEARCH INVOLVED OCEANOGRAPHY, ECONOMICS (ESPECIALLY RESOURCE ECONOMICS), OCEAN ENGINEERING, MARINE TRANSPORTATION, ADMIRALTY LAW, INTERNATIONAL LAW, COASTAL ZONE MANAGEMENT AND FISHERIES. TYING THIS BROAD PACKAGE TOGETHER WITH A WEEKLY SEMINAR IN WHICH OUTSIDE INDUSTRY AND GOVERNMENT REPRESENTATIVES SHARED VIEWS WITH THE FACULTY AND STUDENTS, THE PROGRAM IN MARINE AFFAIRS TRULY PRESENTED AN OPPORTUNITY NOT OTHERWISE AVAILABLE TO EXPLORE THE INTERSTICES AS WELL AS THE LIMITS OF MARINE POLICY.

WHILE I AM CERTAIN THAT THE PROGRAM AT RHODE ISLAND WAS NOT DESIGNED TO COINCIDE WITH THE JURISDICTION OF THE HOUSE COMMITTEE ON MERCHANT MARINE AND FISHERIES, IT MOST FORTUITOUSLY DID SO COINCIDE.

GIVEN THE BROAD EXPOSURE WHICH THIS PROGRAM PROVIDED, I WAS ABLE TO DETERMINE FOR MYSELF THAT AREA WHICH WOULD HARMONIZE BEST WITH THE EXPERIENCE AND TRAINING I HAD BROUGHT TO THE PROGRAM. SINCE MARITIME TRANSPORTATION WAS AND IS AN ACTIVITY ESSENTIAL TO THE FUTURE OF THE UNITED STATES AS A MAJOR TRADING NATION AND SINCE MY PUBLIC UTILITY AND TRANSPORTATION BACKGROUND FIT NEATLY INTO THAT ASPECT OF THE MARITIME ENTERPRISE, I CONCENTRATED MY RESEARCH ON MARITIME POLICY. THE FACT THAT THE CONGRESS WAS AT THAT VERY TIME LABORING WITH THE PROBLEMS OF AN ILL-DEFINED MARITIME POLICY MADE THE CHOICE RELATIVELY EASY.

After completion of the program, I was fortunate enough to be employed by the House Subcommittee on Merchant Marine to continue the work I had undertaken in pursuit of my post-professional Master's Degree. Employed first as economist to the Committee, then later as counsel and since the beginning of the 97th Congress in my current capacity, I have been able to contribute to the much needed change in direction which our merchant marine must take if our role as a maritime power is to continue.

Interestingly enough, the very broadness of the program at Rhode Island attracted a student body which included significant numbers from the Naval War College and the Coast Guard Academy. Regular contact with these people provided all of us with an appreciation for the effect the entire range of marine studies has on our defense policy. For my work, the defense aspects of a strong merchant marine are of paramount importance. The "omnibus" approach towards marine policy education employed in the Rhode Island program makes possible the consideration of finite and specific proposals in the context of their overall effect on marine policy.

I would venture a guess that in the absence of a National College Sea Grant program there would not be any repository for information or a locus for research directed towards work in which the entire range of policy issues must be considered. Instead, Committees such as the one

FOR WHICH I WORK WOULD CONTINUE TO OPERATE IN A VACUUM MOVING IN THE DIRECTION IN WHICH PARTICULAR PRESSURES ARE APPLIED. FOR EXAMPLE APPRECIATION FOR THE ENVIRONMENTAL IMPACT OF MARINE TRANSPORTATION ACTIVITY ON ONE HAND AND AN APPRECIATION BY ENVIRONMENTALISTS OF THE TRANSPORTATION PROBLEMS INVOLVED IN WORK IN WHICH THEY MAY BE INTERESTED WOULD BE LACKING.

MUCH OF THE PROGRESS WHICH HAS BEEN MADE IN SUCH AREAS AS AT-SEA INCINCERATION, RESPONSIBLE AND TIMELY DEVELOPMENT OF OUR CHANNELS AND HARBORS AND THE RECOGNITION OF THE NEED TO HARMONIZE OUR POLICIES WITH OTHER PEOPLES WHO DEPEND UPON THE OCEAN FOR THEIR EXISTENCE ARE FACTS OF EVERY-DAY LIFE IN THE CONGRESS -- I BELIEVE THE SEA GRANT PROGRAM IS, AS MUCH AS ANY OTHER FACTOR, RESPONSIBLE FOR THIS NEW WAY OF LOOKING AT THE OCEAN AND THE THINGS WE DO WITH IT.

Senator PELL. Thank you very much. Just following up on the intern program, the sea grant intern program, about how many interns a year are there, fellows, and where do they go?

Mr. SEIFERT. Our committee usually utilizes the services of upward of six per year. They generally continue to work in the areas of concentration which they have specialized in at the university. Consequently they invariably end up in the Subcommittee on Oceanography and the Subcommittee on Fisheries, Wildlife, and the Environment.

Senator PELL. What about on the Senate side? I do not recall any number over here.

Mr. SEIFERT. I am not familiar with the use which the Senate makes of fellows, although I am familiar with one. Senator Gorton 2 years ago had a fellow from the University of Washington program who later became counsel to the Subcommittee on Merchant Marine when Senator Gorton chaired that subcommittee. I know the young man myself, and he did a very fine job.

But I cannot speak to the use of interns in the Senate generally.

Senator PELL. Are there any other similar programs that the sea grant program has funded to fill needs outside those you have mentioned?

Mr. SEIFERT. I believe the University of Washington program, which is law based, provides a broad based program with a master's degree in marine affairs, not dissimilar from that provided for at the University of Rhode Island; however, it is reposited at the law school of the University of Washington and consequently has a different focus.

Senator Pell. In other words, you can take a law degree at the University of Washington combined with the marine approach.

Mr. Seifert. Giving you two degrees, one being a master's in marine affairs.

Senator Pell. Does that include admiralty law, too, or not?

Mr. Seifert. One would hope so. The admiralty law area is one interestingly enough which is not part of many law school curricula. And while Rhode Island as a state does not have a law school at any of its fine institutions, the marine affairs program at Rhode Island does have as one of its electives the study of admiralty law, which I think has benefitted not only Rhode Island, but also other sectors in other states who have lawyers sent to that university to study marine affairs, including admiralty law.

Senator Pell. Is there any law school teaching exclusively admiralty law, giving a degree in admiralty law?

Mr. Seifert. I know of none in the United States; since the study of law is general in scope and since law students are considered generalists in all instances, it is unlikely that you would find somebody giving a degree in admiralty law.

There are graduate programs in which the dissertation might very well involve admiralty subjects, but there is no degree in admiralty law.

Senator Pell. In general, did you find the graduates of the University of Rhode Island, your classmates, did they secure jobs in ocean-related areas?

Mr. Seifert. Yes. Most—many of them, as I indicated in my prepared testimony, came from other parts of the federal establishment, as a matter of fact, and were continuing their studies at the University of Rhode Island, taking a degree in marine affairs to augment the work that they were undertaking at that time.

The Department of the Navy, especially through the Naval War College at Newport, sends a sizable delegation yearly to the University of Rhode Island. And the Coast Guard Academy sends people from the Coast Guard Academy to augment the very capable training that they provide them with, the unusual and highly specialized training that can only be attained at an institution such as that which is funded by sea grant.

Senator Pell. But surely the people from the Coast Guard Academy would not be the students there. They would be on the faculty.

Mr. Seifert. No, sir. They are students.

Senator Pell. They could not be because they have not yet received their BS.

Mr. Seifert. I beg your pardon.

Senator Pell. They have not yet received their BS, their bachelor of science.

Mr. Seifert. Oh, I am sorry; several of them were faculty members at the Coast Guard Academy. I misunderstood. No. They were faculty members at the university—at the Coast Guard Academy, and they used their training to further train midshipmen at the Academy; absolutely a Federal activity, which is engaged in and funded by sea grant funded programs.

Senator **Pell**. Thank you. Mr. Brainard, I was curious why you felt that no program should be more than 3-years in duration and more than $100,000 in amount. Why would you have those limits on them?

Mr. **Brainard**. I believe in Schumacher's thesis; he is an economics type in England, that——

Senator **Pell**. That small is beautiful.

Mr. **Brainard**. Small is beautiful, yes.

Senator **Pell**. He just died a few months ago.

Mr. **Brainard**. I see. I believe in that.

Senator **Pell**. Not because he wrote the book. It was an excellent book. [Laughter.]

Mr. **Brainard**. But on that thesis I feel that we can get more productivity and more creativity out of a group by keeping these programs small, and I am always worried to see a program continue for too long because I think maybe it has lost its focus.

Senator **Pell**. Are there—why do you feel that there should be a 3-year limit?

I see the smallness, but that does not necessarily mean shortness.

Mr. **Brainard**. Because I also indicated, that to get the support from industry, the project after 3 years would be out of the hands of the university since industry will try to get some economic value out of it. So by those premises, it would be less than 3 years.

Senator **Pell**. And I was also a little puzzled by your statement about the marine advisory service because I think you said that continuing advisory services and repeat studies should be avoided if possible. Is that correct?

Mr. **Brainard**. Well, I started off with such things as financing programs to develop shrimp recipes. I think this is giving the entire program a bad name. I said continuing advisory services; this is repeated year after year after year.

I feel that the sea grant is a seed type of money and that certain of these programs could be terminated after they have, you know, started the seed growing.

Senator **Pell**. Let us focus on the shrimp for a moment because one of the first programs it did in the late sixties was to focus on these shrimp farms and to develop actual shrimp farming. I think it was the University of Miami or somewhere in Florida that that was being done. I thought that was a very good program indeed. Why do you think it is wrong?

Mr. **Brainard**. I did not say anything about development of aquacultural techniques. In no way did I say that. I just thought that something like a shrimp recipe should be left to Julia Child.

Senator **Pell**. Are you talking about just the recipe, not the shrimp fisheries?

Mr. **Brainard**. Yes. That is exactly right.

Senator **Pell**. Well, I must say, I can see that, and I did not realize sea grant did fund the development of recipes as well.

Mr. **Seifert**. May I suggest something, Senator Pell; it may very well be that picking out something like a shrimp recipe attracts the opprobrium that Mr. Brainard is justifiably heaping upon it. However, if you look at the sea grant program as I have observed it, and if part of its goal is to develop the resources and if part of developing the exploitation of underutilized species requires a method for preparing those foods so that they are palatable and attractive to those people, and if, as an offshoot of that, there is also a shrimp recipe thrown into a book full of recipes to utilize underutilized species, then I think the program is well served by it.

Senator **Pell**. I see your point. I can remember, I think it was the late forties or early fifties, there was a professor at Yale, Merriman or Merrifield, I think was his name, and he did some research on what we call trash fish or junk fish, pointing out that so many of the fish that are caught are simply not utilized and thrown back in the ocean dead. And if one could develop a recipe to make the preparation of those fish, the result of those fish when cooked pleasing to the human palate, that would be a good objective. I would think in that case, Mr. Brainard, you would—would you think that would be feasible or possible?

Mr. **Brainard**. Well, I am very pleased to see my statement has caused this discussion because I think we have gotten out very many good points.

Senator **Pell**. I thank both of you for being here, and I thank you, Mr. Brainard, for coming down, and you, Mr. Seifert, for coming the length of the Capitol. Thank you very much.

Now, our final witness is Dr. Harris Stewart, director of the Center Marine Studies, Old Dominion University, and chairman of the Committee on International Marine Science programs, National Association of State Universities and Land Grant Colleges.

I have a particular interest in the international programs which I played a role in getting started a few years ago.

I look forward very much indeed to your testimony.

STATEMENT OF HARRIS B. STEWART, JR., CHAIRMAN, INTERNATIONAL COMMITTEE, MARINE DIVISION, NATIONAL ASSOCIATION OF STATE UNIVERSITIES & LAND GRANT COLLEGES, AND PROFESSOR OF MARINE SCIENCE AND DIRECTOR, CENTER FOR MARINE STUDIES, OLD DOMINION UNIVERSITY, NORFOLK, VA.

Mr. **Stewart**. Thank you, Mr. Chairman. I am very pleased to be here. My formal testimony has been made available for the record.

In view of the approaching time to eat our shrimp for lunch, sir, I would like to speak ex tempore very briefly to summarize some of the points that I made in my testimony.

The sea grant international program, as you well know, sir, is an outgrowth of the old international cooperative assistance program that, I believe, you initiated in 1976 as part of the Sea Grant Program Improvement Act of 1976. This later became the sea grant international program. The first international sea grant funding was provided in 1978. Since that time, 12 universities in the United States have worked cooperatively and very closely on marine programs in other countries, primarily in the developing countries.

The program was funded initially on the order of $900,000 a year. This continued from 1978 up until 1982 when the funds were dropped from $909,000 to $250,000. Since then in 1983 there are no funds for the international program.

As Dr. Knauss and others have pointed out, it is important, particularly with the new political regimes that are developing in the ocean, that the United States work as closely as possible, particularly with these developing States, as they themselves are extending their exclusive economic zones out to 200 miles. We have real problems with the availability of those zones for U.S. research vessels, for we know the importance of having these countries work with us on such things as fisheries treaties and other activities in the ocean.

It is important that there be a seawise, if you will, a marine intelligent group in these developing countries. If nothing else, we can negotiate and talk with them. Other than this, of course, there is the humanitarian aspect of helping developing countries, plus the fact it develops new markets for U.S. marine goods.

But what has the program involved to date? The program, just to give a very quick rundown, has included such things as cooperative work on faculty exchange in the Marine Extension Service in the South Pacific. This has been done through the University of Hawaii, working with 11 island nations in the South Pacific; providing marine science and education in Chile and Mexico; improving small harbor engineering in India; training scientists and students in Egypt in microbiological techniques for pollution monitoring and management and Chilean students in coastal research methods; training Costa Ricans in marine resource assessment and pollution studies; training Israeli scientists and students in wave studies and modeling; training people in Malaysia, a program generated through Dr. Nelson Marshall in your own Rhode Island institution; working to provide education to the people in Malaysia relative to their marine resources.

As a matter of fact, that program is the one that made the strongest tie-in with the local economic community, working with local economists who have been strongly involved in the URI program in Malaysia.

The program has had an outgrowth of interest in mangroves and the problems of mangroves and their ecology which the Malaysians themselves are now picking up.

I think the program has been successful to date, Mr. Chairman. And one of the reasons is that it has had an absolute minimum of the bureaucratic redtape in which so many government-to-government programs get bogged down. This is not a government-to-government program. Sea grant international has been an institution-to-institution program. And it was early realized that if there was going to be cooperation in marine science, that the first step was one of education and training.

So the sea grant international program has concentrated very heavily on the education and training of people in these countries. One of the essentials is that there be a cooperating institution in the host country cooperating with a U.S. institution so that when the U.S. researchers leave, something is left behind; in contrast to some U.S. foreign programs where it is merely U.S. scientists doing their own thing in a different locality.

Sea grant international involves education and training of people in those countries. It has been highly successful. I strongly recommend that it do in fact be continued, particularly at the $5 million level which you suggested for each of the succeeding years.

My hat today, Mr. Chairman, is not as director of the center for marine studies at Old Dominion University, but rather as the chairman of the international committee of the Marine Division of the National Association of State Universities Land Grant Colleges.

Thank you.

[The prepared statement of Mr. Stewart follows:]

Statement of Dr. Harris B. Stewart, Jr., Chairman, International Committee of the Marine Division of the National Association of State Universities and Land Grant Colleges (NASULGC), Professor of Marine Science and Director, Center for Marine Studies, Old Dominion University, Norfolk, Virginia, before the Senate Education Arts, and Humanities Subcommittee of the Committee on Labor and Human Resources, April 7, 1983.

Mr. Chairman, gentlemen, it is indeed an honor to be asked to appear before this Subcommittee and a pleasure to speak in support of S-655, the Sea Grant reauthorization bill, but particularly in support of Sea Grant's international component, the Sea Grant International Program (SGIP).

Although I am a full-time faculty member at Old Dominion University, I am today appearing in my role as Chairman of the International Committee of the newly formed Marine Division of NASULGC. That Committee is the present version of the Sea Grant Association's International Marine Science Program Committee of which I was the Chairman before it was incorporated into NASULGC. I have been active in the international aspects of marine science since joining the old U.S. Coast and Geodetic Survey as Chief Oceanographer in 1957 and through its various metamorphoses into ESSA and NOAA from which I retired in 1978 as Director of NOAA's Atlantic Oceanographic and Meteorological Laboratories in Miami. I have participated on various committees of the National Academy of Sciences dealing with international marine science and marine technical assistance to developing countries. Presently, I also serve as the U.S. National Associate to IOCARIBE, the Caribbean Regional Association of the Intergovernmental Oceanographic Commission of UNESCO, and have been the IOCARIBE Vice-Chairman since 1978. This is merely background as to my qualifications to speak to you today on the importance of the Sea Grant International Program.

The Sea Grant Program Improvement Act of 1976 (Public Law 94-461, 90 Stat. 1961) established the International Cooperative Assistance Program, later renamed the Sea Grant International Program (SGIP). The goals of the program are to enhance the research and development capability of developing foreign nations with respect to ocean and coastal resources and to promote the international exchange of information and data with respect to the assessment, development, utilization, and conservation of such resources. These are the goals, but what are the results since the program's first year of operation - 1978? Funded at less than one million per year, joint porjects have taken plance between U.S. universities and their marine counterparts in Colombia, Costa Rica, Egypt, Israel, Malaysia, and the South Pacific, plus two projects each in Chile, India, and Mexico. Unlike some other foreign research projects where U.S. investigators are merely doing their own research in a foreign locality, Sea Grant International requires a cooperating institution in the host country, insists that it be a truly cooperative project, and that education and training of the foreign nationals be an integral component. Thus, something of value is left behind when the U.S. part of the team comes home.

Over the years, it has been realized by the U.S. marine science community, as well as by the IOC, IOCARIBE, and other international organizations, that if the developing coastal states are to be able to explore for, exploit, and successfully manage their marine resources and contribute meaningfully to our understanding of the global sea in all its magnificent complexity, it is absolutely essential that a major effort be directed to the training and education of marine scientists and technicians in the developing countries. In view of the recent rapid changes in the political climate affecting the world ocean, this training and education aspect has become increasingly important and is an essential element in the Sea Grant International Program. If the United States is to negociate with the developing countries on matters relating to fisheries, research vessel access to exclusive economic zones (EEZ's), and other ocean matters, it is to our advantage to deal with individuals who have an oceanic awareness and understanding. Education is the key, and the Sea Grant International Program, underfunded though it has been to date, is probably the best mechanism presently available to the United States for the delivery of marine technical and educational assistance to the developing countries. A good rationale for U.S. marine technical assistance to and cooperation with developing countries is presented in the publication of the Marine Technical Assistance Group of the Ocean Policy Committee of the National Research Council entitled "Marine Technical Assistance to Developing Countries: the U.S. Role" published in 1982 by the National Academy Press:

> "By providing technical assistance to developing countries in the assessment, development, and management of the marine resources off their coasts, the United States not only fulfills important humanitarian obligations but also can derive economic, scientific, and other benefits as well as political advantage. Potential economic benefits from technical assistance cannot be predicted with certainty but could also include the creation of markets for marine equipment, services, and expertise. Economic benefits also could come from joint development of resources in the exclusive economic zone and from fostering conditions favorable to future investment by U.S. industry. To the extent that marine technical assistance promotes economic growth and is seen as assistance rather than exploitation, it can contribute to international political stability as well as build support for U.S. policies in international forums".
>
> "The scientific returns on technical assistance and cooperation include access to coastal waters of developing countries and the research contributions of colleagues familiar with local ocean conditions and phenomena. Exclusive economic zones, occurring on the ocean boundaries of land masses, include many unique oceanographic features. Joint operations with scientists from coastal developing countries hold the potential for mutual benefits for all participants. Cooperative data collection and analysis further such shared interests as navigation, weather and climate prediction, marine fisheries management, and environmental ptotection. Technical cooperation programs also offer a way for researchers from developed nations to provide for coastal state participation, and data sharing will be required under the Law of the Sea Treaty".

Table I.

SGIP PROJECTS SUPPORTED TO DATE

GRANTEE INSTITUTION	DEVELOPING COUNTRY	DURATION	CUMMULATIVE FUNDING	COMPLETION DATE
Univ. of Hawaii	So. Pacific Nations	3 years	$ 288,500	1982
Oregon State Univ.	Chile and Mexico	5 years	492,500	1983
Univ.of California	Mexico	3 years	240,000	1982
Florida S.G.Program	India	1 year	19,300	1980
Louisiana State Univ.	Mexico	3 years	104,200	1983
Maryland S.G.Program	Egypt	2 years	134,400	1982
Univ.of Rhode Island	Malaysia	4 years	379,900	1982
New York S.G.Inst.	Chile	3 years	72,000	1981
Univ. of Delaware	Costa Rica	4 years	623,500	1982
VIMS/South Carolina	Israel	2 years	148,800	1981
Univ. of Miami	Colombia	3 years	311,500	1982
Lehigh Univ.	India	2 years	175,000	1982
TOTAL	----------------------------		$2,989,600	

As mentioned earlier, SGIP is the best mechanism presently available for the delivery of U.S. marine technical assistance to developing countries. This is due to several factors. The first of these is that SGIP as an institution-to-institution program has none of the bureaucratic red tape involved in the administration of government-to-government programs. Actually, SGIP is more of a scientist-to-scientist program, as the U.S. institution is required to have a host country counterpart institution, and this normally entails the U.S. principal investigator working out a cooperative arrangement with a scientific colleague in the host country. It is certainly not a "give awayprogram", but rather one in which scientists at an institution in the U.S. and at one in the developing country work out a mutually agreeable research project in the host country, a project that not only addresses a local marine problem but also entails a significant element of education and training. U.S. investigators liked it, and their counterparts in the developing countries liked it. The program worked well - that is, it worked well until FY-1982 when the annual funding level was reduced from $900,000 to $250,000 followed by the total elimination of funding in FY-83. Needless to say, I support the concept of a reauthorization for the Sea Grant International Program at the proposed annual level of $5 million.

But what has SGIP accomplished to date? Table I lists the 12 U.S. universities that have received SGIP funding, the cooperating developing country for each, the Sea Grant Funding involved, and the completion date of each project. This, however, is a sterile list and reflects nothing of the projects themselves nor of the really worthwhile and even exciting marine science activities. Summaries of the 12 funded SGIP projects follow. These cover cooperative work on faculty exchange and a marine extension service in the South Pacific, improving marine science education in Chile and Mexico, improving small harbor engineering in India, training

Egyptian students in microbiological techniques and Chilean students in coastal research methods, training Costa Ricans in marine resouce assessment and pollution studies, training Israeli scientists and students in wave studies and modeling relative to coastal zone management, marine science training relative to the pollution in Cartagena Bay, Colombia, and training Indian students in engineering properties of marine sediments. Details on each of the projects funded to date follow:

University of Hawaii - University of the South Pacific

The University of the South Pacific serves the educational needs of eleven Pacific island nations: Solomons, Fiji, Tuvalu, Kiribati, Vanuatu, Cook, Nauru, Niue, Tokelau, Tonga, and Western Samoa. The project is led by Dr. Philip Helfrich and Dr. Jack Davidson of the University of Hawaii and Dr. Uday Raj of the University of the South Pacific. Objectives are (1) to conduct a faculty exchange program between the two universities in order to improve tropical marine science course offerings and overall professional improvement, (2) to establish a functional marine extension service at the University of the South Pacific, and (3) to evaluate the program and develop a follow-up plan.

During the past year a seminar/workshop was held on the use and management of inshore marine resources of tropical Pacific islands. The meeting was attended by faculty members of both universities, representatives of local government and industry, and students in the USP departments of fisheries and marine sciences. Proceedings are being prepared for publication.

With respect to the establishment of marine extension service in the South Pacific, two new agents have been hired. The first, Mr. Johnston Seto from Fiji, is being trained in fisheries management. The second, Mr. Steven Halapua from Tonga, has a background as a resource economist and is presently doing survey work in Tonga before going to the University of Hawaii for additional training in extension techniques.

Some other activities included a baseline study of the first oil exploration on a South Pacific coral reef, exchange of publications, four satellite conferences via PEACESAT, and production of extension materials.

Oregon State University - Chilean and Mexican Universities

This project "An International Cooperative Assistance Program for Latin America (with Emphasis in Chile and Mexico)" involves personnel from Oregon State, the Catholic University of Valparaiso, and other Chilean and Mexican universities. The principal investigators are Dr. William Q. Wick and Dr. Victor Neal of Oregon State.

Objectives are (1) to determine suitable opportunties for marine advisory service activities in Latin America; (2) to transfer knowledge of coastal processes and techniques of study to Chilean colleagues by means of an academic course, a sampling program, and technician

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training; (3) to apply remote sensing capabilities of NIMBUS-7 satellite to study the physical, chemical, and biological nature of the waters off Chile; (4) to conduct workshops on modeling approaches and fisheries technology with Latin American personnel; (5) to train Mexican students and scientists in marine mammal research and management; and (6) to continue support for distribution of the newsletter "Exposure."

During the past year a workshop on marine advisory services was planned for December 1980 at the University of Chile at Antofagasta; a short course on beaches and estuaries was held at the Catholic University of Valparaiso; and a workshop entitled "The Role of Dynamic Models in Fishery Management" was held at the University of Chile at Osorno. Chlorophyll maps produced from satellite surveillance have not yet been released, and this has delayed accomplishment of the third objective given above. The training of Mexican personnel in marine mammal management will be carried out in the coming year.

In addition to scheduled activities, Sea Grant funds have been used to support travel of faculty members to Chile to teach short courses in fish disease and the aquaculture of salmonids.

University of California - Mexican Universities

This project "Informational and Education Assistance to Marine Science Institutions in Mexico" involves people from the University of California Sea Grant College Program; Instituto Nacional de Pesca; Escuela Superior de Ciencias Marinas, Ensenada; Universidad Autonoma de Baja California; Centro de Investigaciones y de Educacion Superior de Ensenada; Centro de Investigationes Biologicas, La Paz; and Universidad Autonoma de Baja California Sur, La Paz. The principal investigators are Dr. Richard A. Schwartzlose and Dr. George T. Hemingway.

Principal objectives are (1) to train a self-supporting, self-perpetuating cadre of marine research technicians for the Mexican science community; (2) to acquire reprints, volumes, and hard copies of documents and journals for the Mexican institutions; (3) to provide short courses for faculty and staff members of the Mexican institutions; and (4) to provide access upon request to short-term, intensive training through attendance at summer courses by faculty members of the Mexican institutions.

During the past year thirteen lectures were offered at Escuela Superior de Ciencias Marinas, Ensenada, on a wide variety of marine science topics. The teachers volunteered their time, and Sea Grant paid their travel expenses. Seven lectures are now being offered during the Fall term at Centro Interdisciplinario de Ciencias del Mar, the marine science campus of the Instituto Politecnico Nacional. Dr. Richard Eppy held a three-day workshop on analysis of chlorophyll and determination of primary productivity; Ed Coughran, Director of the UCSD Computer Center, taught computer programming at Ensenada; Dr. Geoff Moser of the NOAA Southwest Fisheries Center spend a week in Mexico City teaching identification of California Current icthyoplankton; and Drs. Zedler and Hazen gave a week-long course in the field and classroom on coastal lagoons and antiestuarine ecosystems.

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The longest course was five months in duration. Two oceanologists, Victor Moreno and Armando Rosas of the Instituto Nacional de Pesca, learned deep-sea reversing thermometer technology. They are now prepared to start a thermometer calibration laboratory in Mazatlan.

University of Florida - Indian Institute of Technology, Bombay

This one-year project, entitled "A Short Course on Small Harbor Engineering in India," has been completed. It was under the direction of Dr. A. J. Mehta of the University of Florida and Dr. S. Narashimhan of the Indian Institute of Technology.

The objective of the course was to review coastal engineering requirements for the design and maintenance of small and intermediate size commercial harbors. These harbors are a key factor in the growth of maritime trade, including the export of seafood products such as frozen shrimp. In response to the need for projected increases in these exports, the government of India has conceived a master plan to improve existing harbors and construct a number of new ones. This course served as a forum to identify coastal engineering problems and to work out solutions that might assist engineers in the design and maintenance of the planned harbors.

The short course was held January 2-13, 1980, at the Indian Institute of Technology, Bombay. Partial support was provided by the Dredging Corporation of India (New Delhi), Central Water and Power Research Station (Pune), and the National Institute of Oceanography (Goa). There were 57 participants in the short course, most of them engineers from existing ports, but with several from academic and governmental institutions. Fifteen Indian and four foreign speakers dealt with topics such as the physical regime of the Indian coastline, design wave and wave force computations, estimation of coastal and estuarine sediment transport, inlet stability and sand bypassing, the design and economics of harbor structures, case studies of harbor models, and dredging as a key engineering and economic factor in harbor design. Thirty-two of the participants took part in a formal evaluation of the short course, with most of them reacting quite favorably. Lecture notes were bound into three volume sets and distributed to the participants as well as to interested agencies.

Louisiana State University - Universidad Nacional Autonoma de Mexico (UNAM)

This project "An Ecological Program for the Laguna de Terminos (Campeche, Mexico) with Special Reference to Fishery Resources and the Potential Impacts of Man" is under the leadership of Dr. John Day of LSU's Center for Wetland Resources. His Mexican counterpart is Dr. Alfredo Laguarda, Director of UNAM's Center for Marine Sciences and Limnology.

During the past year, the objectives of the project were (1) to continue a cooperative study of management topics associated with the shrimp fishery of Laguna de Terminos, (2) to transfer the programs and data of a hydrodynamic model to Mexican scientists and train them in its use, and (3) to continue to train students in field studies necessary to complete an ecosystem analysis. All of these objectives have been substantially achieved.

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Maryland Sea Grant Program - High Institute of Public Health, Alexandria

This project "Strengthening Environmental Microbiology and Pollution Monitoring Capabilities at the High Institute of Public Health, Alexandria, Egypt" involves personnel from The Johns Hopkins University and the Department of Microbiology at the High Institute. Principal investigators are Drs. Kazuyoshi Kawata and Vincent P. Olivieri in the Division of Environmental Health Engineering at Johns Hopkins.

The specific objectives are (1) to hold workshops on recent environmental microbiological techinques, (2) to train microbiology students in the tracer virus technique in field research and monitoring, and (3) to hold a seminar on environmental microbiological studies in tropical waters during each year of the two year project.

In March 1980 the principal investigators presented a three-day seminar to twenty-two persons from the High Institute of Public Health, the Egyptian Institute of Medical Research, the Faculty of Pharmacy, and NAMRU-3 (a U.S.Navy medical research unit based in Cairo). Sixteen students then spent the following three weeks in a workshop on such topics as enumeration of pathogens in canal water and wastewater, bacterial viruses in water, the die-away of selected microorganisms in water, field measurements at a Mediterranean outfall, and the process of disinfection.

When the investigators returned to the United States in April, they were accompanied by Dr. Thoraya El Shasley, a lecturer at the High Institute who came to spend four months at The Johns Hopkins University as a post-doctoral fellow. She has since returned to Egypt and is continuing work in culturing and enumeration techniques.

University of Rhode Island - Malaysian Universities

This project "Cooperative Development of Marine Resources Capability in Malaysia" involves people from URI, Universiti Malaya, Universiti Pertanian Malaysia, and Universiti Sains Malaysia. Project directors are Drs. Nelson Marshall and Harlan Lampe of URI.

Objectives are (1) to retrain professionally qualified Malaysian economists in fisheries economics methods, (2) to improve the teaching of fisheries economics at the Malaysian universities, (3) to assess current economic conditions in the fisheries sector on the east coast of Peninsular Malaysia, (4) to strengthen university capability to handle instruction and research in fish population dynamics and to introduce research basic to fish management, and (5) to work with Malaysian faculty members to develop research projects that will permit the role of mangroves to be determined and factored into coastal management decisions.

During the past year, seminars related to fisheries economics issues were presented, analysis of costs and earnings of small-scale fisherman was begun, four students received advice on fisheries related theses, and

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computer programs were adapted for use at the Malaysian universities. An international symposium on mangrove ecosystems was held, and papers with joint Malaysian-American authorship were delivered. Several Malaysian faculty members have spent short periods of time at URI for further study. Although not funded by Sea Grant, Captain Mohammed Ibrahim--a key faculty member of the fisheries/marine science group at Universiti Pertainian Malaysia--has completed the Master of Marine Affairs Program at URI and is enrolling as a PH. D. candidate in the Graduate School of Oceanography.

New York Sea Grant Institute - University of Concepcion, Chile

This project "Strengthening Marine Sciences Capabilities and Programs at the University of Concepcion, Chile" involves personnel from the Marine Sciences Research Center at Stony Brook and the Department of Marine Biology and Oceanography at the University of Concepcion. The principal investigators are Lisandro A. Chuecas, Chairman of the Department of Marine Biology and Oceanography at the University of Concepcion, and Iver W. Duedall, Associate Professor of Chemical Oceanography at the Marine Sciences Research Center.

The overall objective is to train Chilean university personnel so they can carry out research which contributes to coastal management in Chile. Specific objectives are (1) to train faculty members in research methods which are used in coastal research and (2) to supplement the teaching and research programs at the University of Concepcion.

During the past year several faculty members from the University of Concepcion spent short periods at the Marine Sciences Research Center taking courses, attending seminars, and planning cooperative research projects. Faculty members from the Marine Sciences Research Center also offered courses and provided thesis guidance at the University of Concepcion. Professor Marcos Retamal (UC), for example, began work with Dr. Peter Weyl (MSRC) on the establishment of a marine resources inventory for Region VIII in Chile. After consultatin with experts in Virginia, Maryland, and New York, Professor Irene Lopez (UC) prepared a manual on the culture of shellfish. The presidents of the two universities recently met to renew the memorandum of understanding under which this cooperative project is carried out.

University of Delaware - University of Costa Rica

This project "Joint University of Costa Rica/University of Delaware Marine Studies Program: Manpower Training and Pollution Assessment" involves people from the Delaware Sea Grant College Program and several departments at the University of Costa Rica. Objectives are (1) to work with Costa Rican trainees in carrying out a preliminary ecological assessment of marine resources in the Gulf of Nicoya, (2) to study the effects of current circulation on pollutant dispersion in the Gulf of Nicoya, (3) to provide a well-equipped modern and economical research

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vessel for training and research, and (4) to continue an on-going exchange of personnel between the two universities for training graduate students and technicians.

During the past year, cooperative training and research continued in the areas of general marine ecology, chemical and physical oceanography, remote sensing, and operation and maintenance of the research vessel. Dr. Manuel Murillo, Vice-President for Research at the University of Costa Rica, continued to coordinate support activities, while the training of junior scientists, students, and boat personnel was directed by Drs. Charles Epifanio, Vic Klemas, and Don Maurer and Captains Donald Evans, Timothy Pfeiffer, and Thomas White of the University of Delaware. Two young scientists--Ana Dittel and Jose Vargas--who are presently faculty members at the University of Costa Rica, organized and supervised a group of undergraduates who took part in cruises and participated in analysis of data. Rolando Hofmeister, who had studied marine biology as an undergraduate at the University of Costa Rica, continued to serve as apprentice boat master and by year's end was competent to serve as captain of R/V Skimmer.

Three papers based on research conducted during the past year are presently in preparation and both Ana Dittel and Jose Vargas are involved in preparation and authorship.

South Carolina Sea Grant Consortium - Israel National Oceanographic Institute

This project "Improvement and Application of Ocean Wave Data Acquisition and Modeling Techniques for the Facilitation of Coastal Management Decisions in Israel and in the U.S." is led by Dr. Victor Goldsmith from the University of South Carolina and Dr. Abraham Golik from INOI.

The project aims to strengthen the capabilities of both Israeli and U.S. scientists in the field of wave information and coastal zone planning. Specific objectives are (1) to train Israeli personnel in wave measurement and modeling techniques, (2) to exchange and compare wave data obtained in the same manner, and (3) to improve Israeli advisory service activity in the field of wave information and coastal zone planning.

Despite the normal disruption involved in the transfer of this project from one academic institution to another, during the past year the training of Israeli scientists and technicians continued, a directional wave gauge was installed and operated south of Haifa, a scientific paper employing wave data was published, and another paper has been submitted for publication. In order to promote international exchange of marine information, a permanent data bank of all regional wave information was created. Although data analysis is not yet completed, several requests for synthesized data have been answered.

University of Miami - Colombian Institutions

This project "Marine Resources and Environmental Sciences Training and Information Exchange Program for Colombia" is under the direction of

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Dr. Francis Williams, Professor in the Division of Biology and Living Resources at the Rosensteil School of the University of Miami.

Objectives are (1) to provide a series of lectures and seminars on the principles of multidisciplinary research and the application of these principles to tropical coastal areas such as Cartagena Bay and (2) to provide on-the-job experience in the design, planning, execution, and coordination of field and laboratory programs to provide the data needed for development of plans to manage coastal resources, through an integrated study of Cartagena Bay.

During the first year, emphasis was on completion of formal training courses for Colombian university students and faculty members, together with government scientists and technicians. Field studies in Cartagena Bay were also started. The second year saw the continuation of the broad scale multidisciplinary study of Cartagena Bay designed to provide an essential part of the data necessary for managing the area. Equally important, the study has simultaneously provided excellent on-the-job training in the field and laboratory for a large cadre of Colombian scientists, technicians and university students.

The Cartagena Bay study consists of hydrodynamical, chemical and biological tasks. As each part of the study becomes familiar to Colombian personnel, the principal role of the Miami staff has shifted to one of quality control, general supervision, and providing continuing impetus for progress. The hydrodynamical and chemical tasks have proceeded on schedule and have already produced valuable results. The biological work is somewhat behind schedule because of lack of a suitable boat. The third and final year will see completion of the field sampling, an increasing effort on analyses and interpretation of results, and report writing.

Lehigh University - Indian Institute of Technology, Kanpur

This project "Graduate Education in Geotechnical Ocean Engineering at the Indian Institute of Technology, Kanpur" is under the direction of Dr. Adrian Richards, Director of the Marine Geotechnical Laboratory at Lehigh University. His counterpart at the Indian Institute of Technology is Dr. Umesh Dayal.

The overall objective of this education project is to increase the capabilities of Indian ocean engineers in the field of geotechnology. Specific objectives are (1) to train Indian students in the design, construction, and testing of geotechnical equipment; (2) to introduce students to field work by beginning geotechnical research on the stability of Ganges Delta sediments; (3) to facilitate international exchange of information and data between the two institutions; (4) to compare and contrast Ganges data with existing data from the Mississippi Delta; and (5) to organize a short-term intensive course in ocean engineering.

A grant of $175,000 was awarded to Lehigh University on August 29, 1980, to support this project for the next two years.

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In conclusion, the Sea Grant International Program provides an uniquely efficient mechanism for delivering U.S. marine technical assistance to developing countries. The funding to date has been minimal even to initiate such a program, but the results indicate that the SGIP is a good program, that both the developing countries and the U.S. institutions have benefited, that training and education have been important elements of each project, that administrative red tape has been almost non-existant, and that in comparison to other foreign aid programs, this one has been highly cost-effective. In the light of the program's past record of accomplishment and the increasing importance to the United States of maintaining close marine science ties with the developing nations in a time of changing international marine politics, it would seem to be a prudent use of federal funds to continue the Sea Grant International Program at the authorized level of $5 million proposed in the Senate reauthorization bill.

I have enjoyed appearing before this distinguished Senate Subcommittee this morning and will be glad to answer any questions the members might have.

Senator PELL. Thank you very much. The actual money that you have to work with now is, as you know, is a lot less than $5 million. If you had $5 million, if the authorization is fully funded, what do you see being done in this field?

Mr. STEWART. This would be first a very real boost. If it were funded at that level, and hopefully it will be, this would be a real boon to the researchers and institutions in the United States to increase their contacts with institutions in developing countries and come forward with good proposals.

I am a firm believer that when the funding is there on the barrelhead, the people you need to do the work come up out of the woodwork. And they would indeed do this. I think it would be a very real boost to the program.

One part that has not been covered to date has been Africa south of Egypt. There have been no programs, sea grant international programs, there. One of the things I understand they would like to do is use the technique that has been worked out between the Scripps Institution of Oceanography and the University at Encinada, Mexico, for the exchange of reprints, publications, books, and articles relating to marine science.

We would like to see this started in some of the African nations; they are just screaming for technical literature which is not now available.

Senator PELL. I think Dr. Knauss testified that the international program was inhibited in enhancing research and development because its mission overlaps portions of AID. I think Dr. Knauss suggested that the international program should emphasize the separate mission of promoting the exchange of information and data as opposed to the AID program. What would be your reaction to that suggestion?

Mr. STEWART. I think there is no doubt that there is in fact some overlap with the AID mission. AID is involved in the assistance to developing countries, and they work very cooperatively with the sea grant international program. When we ran out of funds before we ran out of good proposals 2 years ago, the sea grant international program, through Mr. Bud rock, went to AID, and they in fact picked up and funded four of the proposals that could not be funded under the sea grant international program because of funding limitations.

As of March 15 this year, some 12 proposals have gone from sea grant international to the science adviser's office at AID. They were very well received and are even now being reviewed for possible support by AID.

So there is a cooperative arrangement going on with AID, although there certainly is some overlap. This cannot be denied. As I understand the second part of your question, I would agree that the exchange of documentation and information should in fact be increased. I quite agree. And there are steps outside the sea grant international program now to accomplish some of this.

Senator PELL. Thank you very much indeed, sir. And I look forward to continuing to follow this program very much because to my mind the international program of sea grant has just taken off. I had visions of a much larger program and a very direct relationship on a teaching level, college-to-college level, with institutions outside the United States, more than just on an AID level.

That is why the dissemination of information would fall within this area of utility. And I recognize the way that the program is funded now, it is very hard to do very much because it is so small.

What is the total amount this last fiscal year?

Mr. STEWART. Well, for this fiscal year the total amount is zero.

Senator PELL. But for the last one that it was active?

Mr. STEWART. The last year, as I recall, was fiscal year 1982 in which it was funded at the level of about 250,000. Previous to that it had been 900,000 for each year. So as of the present fiscal year, there is no funding for the international sea grant program.

One final comment, if I may, Mr. Chairman, is that sea grant international, I think, is the finest mechanism available to the United States today to provide technical assistance in marine science and technology to developing countries. As a delivery mechanism it is absolutely magnificent. And it has worked. The United States likes it; the institutions in the developing countries like it.

Senator PELL. I would agree with you. Thank you very much, Dr. Stewart, for being with us.

I again express my gratitude to our chairman, Senator Stafford, for permitting this hearing to be held and me to preside. And the record will stay open for a week for the submission of any extra testimony or questions.

And the hearing is now adjourned.

[Whereupon, at 12:10 p.m., the committee was adjourned.]

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